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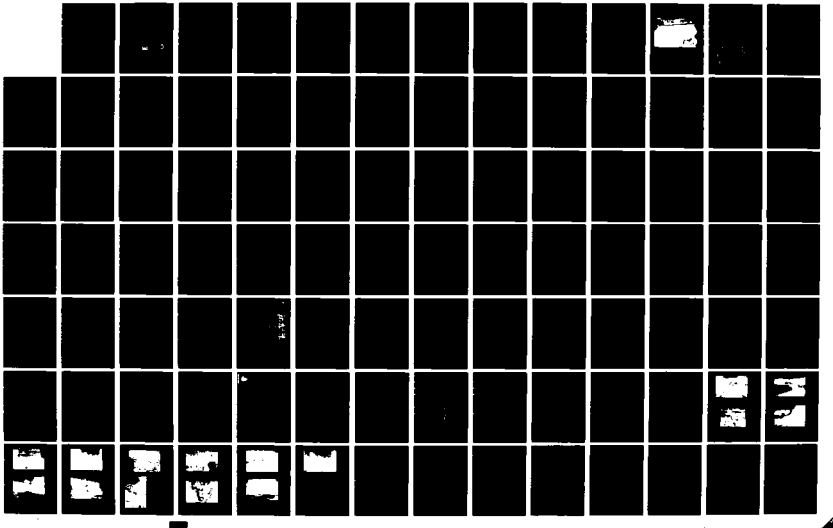

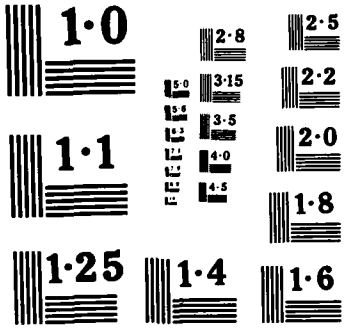

CONNECTICUT RIVER BASIN
OTIS, MASSACHUSETTS

OTIS RESERVOIR DAM
MA 00308

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

AUGUST, 1980

UNCLASSIFIED

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Fall River

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Otis Reservoir Dam is a composite earth and stone masonry dam, about 630 ft. long with a maximum hydraulic height of 31.5 ft. Based on engineering judgement and the past performance of the dam and outlet works, the project is considered to be in fair condition. It has a classification in size of small, and the hazard potential is high. A major breach of the dam could cause appeciable damage to roads and bridges in the downstream area. A number of recommendations are given to be implemented by the owner.

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OTIS RESERVOIR DAM

MA 00308

CONNECTICUT RIVER BASIN
OTIS, MASSACHUSETTS

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT

Identification No.:	MA 00308
Name of Dam:	OTIS RESERVOIR DAM
Town:	OTIS
County and State:	BERKSHIRE, MASSACHUSETTS
Stream:	FALL RIVER
Date of Inspection:	11 JUNE 1980

BRIEF ASSESSMENT

Otis Reservoir Dam is a composite earth and stone masonry dam, approximately 630 feet long with a maximum hydraulic height of 31.5 feet. Tolland Road passes over the top of the dam in a northeast-southwest direction. The top width of the dam is about 30 feet, with the stone masonry face battered at 2H:12V. The upstream face is riprapped with a slope of approximately 3H:1V. A stone masonry spillway with a 1 foot high flashboard is located near the southwest end of the dam. The spillway has a weir length of approximately 38 feet divided in half by a stone masonry and concrete pier which supports a steel stringer bridge above. Two 30-inch by 30-inch stone conduits through the dam serve as a low level outlet for the reservoir. Two sluice gates at the upstream end of these stone conduits are used as regulating gates to control the water level of the reservoir and to partially draw the reservoir down during the winter. The crest of the dam was graded so that the dam may serve as an emergency spillway during high flows. Discharges from the spillway and low level outlets are into the Fall River and then into the West Branch of the Farmington River.

Based on engineering judgement and the past performance of the dam and outlet works, the project is considered to be in fair condition at the present time. The project, however, does have a number of deficiencies which, if not remedied, have the potential for developing into serious conditions.

Because the dam is classified as intermediate size and high hazard potential, the test flood is the Probable Maximum Flood (PMF). The test flood inflow for Otis Reservoir, having a drainage area of 16.0 square miles, was estimated to be 17,600 cfs. In estimating the test flood,consideration was given to the peak reducing effects of the large swamp areas in the northerly half of the watershed. Reservoir storage would reduce the test flood inflow to a routed test flood outflow of approximately 11,900 cfs which would overtop the dam by about 4.6 feet. The combined capacity of the spillway (without flashboards), and the two 30-inch conduits with water at the top of dam is 1100 cfs which is 9 percent of the routed test flood outflow.

The ½ PMF was also analyzed and it was estimated that the dam would be overtopped by approximately 2.3 feet for the ½ PMF routed outflow of approximately 4200 cfs.

A major breach of the dam could cause appreciable damage to roads and bridges in the downstream area. Loss of more than a few lives would also be likely.

A number of recommendations and remedial measures are given in Sections 7.2 and 7.3 for implementation by the owner. These recommendations should be implemented within 12 months of receipt of the Phase I Inspection Report except as noted.

These recommendations, in general, are as follows:

- Engage a qualified Registered Professional Engineer to perform a detailed hydrologic and hydraulic analysis to determine the need for and methods to increase project discharge capacity.

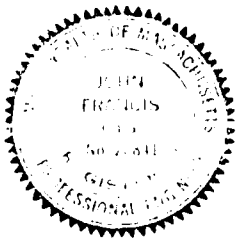
- Engage a qualified Registered Professional Engineer to design repairs for the foundation and supporting structure of the gate house and service bridge, and to design a drainage system for the area at the downstream toe of the dam. Since the dam is expected to act as a spillway during high flows, the downstream toe should be protected against erosion caused by the overflow. In addition, repairs of the two regulating gates and stem guides should be designed and carried out. The Engineer should investigate the impact of flashboards on the stability of the masonry weir and masonry pier at the spillway.

- Leakage noted through the tops of the stone conduits for the low level outlets should be investigated and monitored. This should be done immediately upon receipt of this report.

- Repair or reconstruct the collapsed retaining wall on the north side of the discharge channel for the low level outlets.

Brush and grass should continue to be routinely removed from the joints in the stone masonry and the area along the base of the dam.

The owner should also implement the recommended remedial program including the establishment of a formal operation and maintenance program, and a formal surveillance and downstream warning (emergency preparedness) program. A qualified Registered Professional Engineer should also be engaged to make a comprehensive technical inspection of the dam once a year.



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John F. Cysz
Project Manager
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PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of the Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test Flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

Phase I Investigation does not include an assessment of the need for fences, gates, no-trespassing signs, repairs to existing fences and railings and other items which may be needed to minimize trespass and provide greater security for the facility and safety to the public. An evaluation of the project for compliance with OSHA rules and regulations is also excluded.

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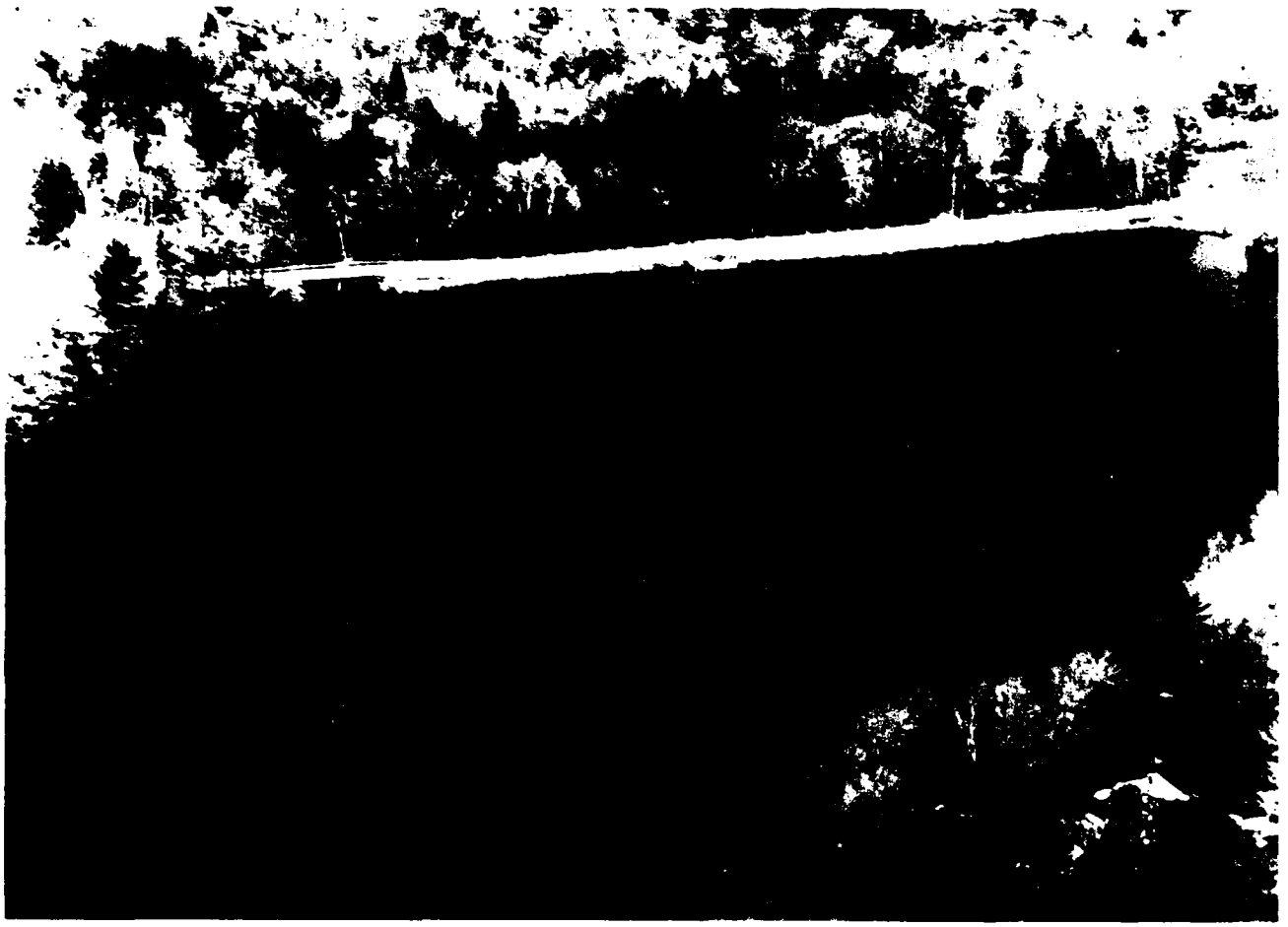
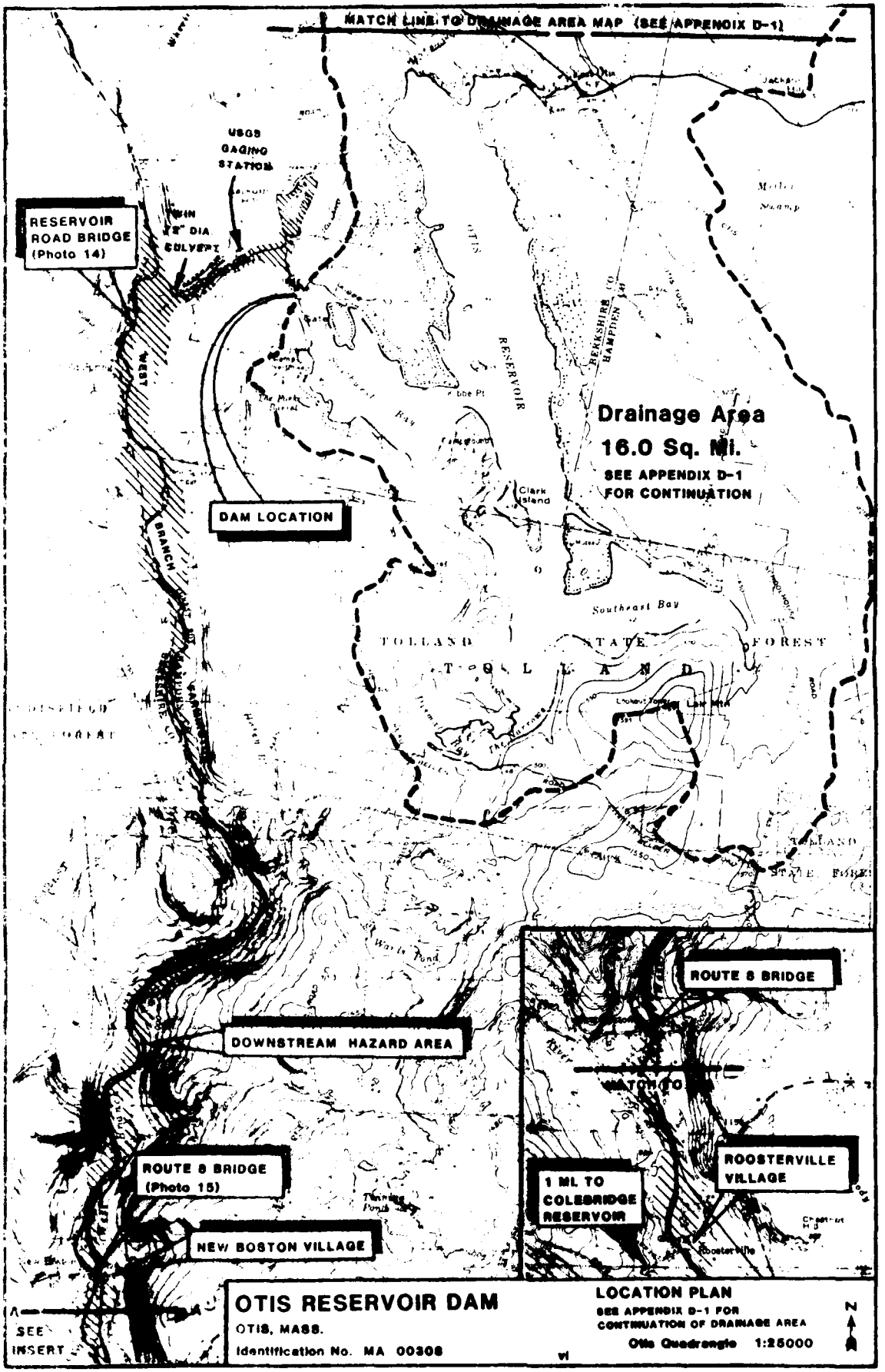


OVERVIEW OF

OTIS RESERVOIR DAM



NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT
OTIS RESERVOIR DAM
SECTION I - PROJECT INFORMATION

1.1 GENERAL

a. Authority

Public Law 92-367, August 8, 1972 authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Robert G. Brown & Associates, Inc. has been retained by the New England Division to inspect and report on selected dams in the Commonwealth of Massachusetts. Authorization and notice to proceed were issued to Robert G. Brown & Associates, Inc. under a letter of 14 March 1980 from William E. Hodgson, Colonel, Corps of Engineers. Contract No. DACW33-80-C-0037 has been assigned by the Corps of Engineers for this work.

b. Purpose of Inspection

(1) To perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.

(2) To encourage and prepare the States to initiate quickly, effective dam safety programs for non-Federal dams.

(3) To update, verify and complete the National Inventory of dams.

1.2 DESCRIPTION OF PROJECT

a. Location

Otis Reservoir Dam is located in the Town of Otis, Massachusetts. The dam is on the Fall River approximately 0.91 miles upstream from the river's confluence with the west branch of the Farmington River. The dam impounds Otis Reservoir which is one of the largest recreational water bodies in Western Massachusetts. Otis Reservoir Dam is shown on the USGS Tolland Center, Mass. - CT Quadrangle at Latitude 42° 09.6' and Longitude 73° 03.5'. Access to the damsite is by Tolland Road which passes over the dam.

b. Description of Dam and Appurtenances

Otis Reservoir Dam is a composite earth and stone masonry dam, approximately 630 feet long with a maximum hydraulic height of 31.5 feet.

The top of the dam has a width of about 30 feet and carries Tolland Road which has a bituminous concrete paved width of 20 feet. The downstream face is cut stone masonry with mortared joints, having a batter of 2H:12V. The upstream face is approximately 3H:1V and is protected by dumped stone riprap. (See photographs 2 and 3, Appendix C.) According to available drawings and

SECTION 4
OPERATIONAL AND MAINTENANCE PROCEDURES

4.1 OPERATIONAL PROCEDURES

a. General

Operational procedures for the dam are not formally established but are based on the experience of the operating personnel.

b. Description of any Warning System in Effect

There is no formal warning system in effect. During the summer the dam is viewed several times a day by the Division of Forest and Parks personnel from Tolland State Forest.

4.2 MAINTENANCE PROCEDURES

a. General

There is no formal maintenance manual for the project. Maintenance is carried out as needed.

b. Operating Facilities

Brush is cut from the top of the dam and downstream toe area about [illegible] a year. The gasoline engine is started once a week, and the engine and gear box used for operating the two gates receive periodic maintenance. An underwater inspection of the gates and stone conduits was conducted in April [illegible] (see report in Appendix B). The underwater inspection team removed debris lodged in one of the gate openings.

4.3 EVALUATION

A formal written operational and maintenance plan, including an annual comprehensive technical inspection by a qualified Registered Professional Engineer, should be developed to insure that problems which are encountered can be corrected within a reasonable period of time. A formal written surveillance and [illegible] warning (emergency preparedness) plan should be established for [illegible].

The major deficiencies noted during the investigation are, in general:

- movement of the gate house which is causing the stem guides for the two 30-inch by 30-inch gates to bind.

- leakage through the roofs of the two 30-inch by 30-inch stone conduits.

- seepage at the downstream face and toe of the dam.

- need for protection against erosion of the crest and downstream toe of the dam during emergency overflow.

- partially collapsed stone retaining wall for the low-level outlet discharge channel.

- rusting of steel bridge over the spillway.

About 120 feet downstream of the stone conduit outlets, there is a concrete structure with steel racks and a steel grate footbridge. The top of the steel racks are about 3 feet higher than the outlet inverts of the stone conduits. According to the Division of Forest and Parks personnel this concrete structure was constructed by the Farmington River Water Power Company for the purpose of trapping fish carried out of the reservoir when the low level outlets were open. The fish screens are now missing and the footbridge has been vandalized. This structure can be seen in Appendix C, Photograph 11.

d. Reservoir Area

The 15-mile shoreline of Otis Reservoir is largely developed with summer cottages, and private and public recreation areas. The shoreline in the area of Tolland State Forest is undeveloped except for campsites and a public boat launching area. Ownership of the reservoir shoreline up to a certain elevation (approximate elevation 1424) is claimed by the Department of Environmental Management which acquired the dam and flowage rights from the Farmington River Water Power Company. Data relative to the depth of the reservoir is given on Sheet 18 of Appendix D. The reservoir is reported to have a mean depth of 22 feet and a maximum depth of 48 feet. There are several small islands within the reservoir with the largest being Clark Island.

e. Downstream Channel

There are two downstream channels; one from the low-level outlet and the other from the spillway.

The channel for the low-level outlet (two 30-inch by 30-inch stone conduits) is contained by stone retaining walls for a distance of about 20 feet downstream of the dam. The northerly retaining wall is partially collapsed and requires repairs. About 120 feet downstream of the dam there is a concrete and steel structure which formerly served as a fish trap. This structure has been vandalized and no longer serves its intended purpose (see Appendix C, Photograph 11). Approximately 100 feet downstream of the fish trap structure, the channel falls over an almost vertical drop. (See Appendix C, Photograph 12.) The spillway channel lies on bedrock and has a steep gradient. Trees and brush were noted growing and overhanging the channel. The spillway channel converges with the low-level outlet channel approximately 300 feet downstream of the dam.

3.2 EVALUATION

Visual observations made during the course of the investigation revealed several deficiencies which at present do not adversely affect the adequacy of the dam. However, these deficiencies do require attention and should be corrected before further deterioration leads to a hazardous condition. Recommended measures to improve these conditions are given in Section 7.

The upstream face of the dam above the waterline is covered with dumped riprap. No undercutting of the riprap or roadway was observed.

c. Appurtenant Structures

A wood-framed building (18 feet by 20 feet), housing the operating mechanisms for the two 30-inch by 30-inch low level outlets, is located near the center of the dam (see Appendix C, Photographs 1 through 4). The gatehouse was constructed about 1901 and is supported on a single concrete center pier running the width of the building. A steel stringer service bridge spans from concrete abutment piers at the top of the dam across the center pier as shown in Photograph 3. The abutment piers are tipped toward the reservoir and are about 2" out of plumb. The center pier is also tipping forward causing the gate stem guides mounted on its face to bind the gate stems. The abutment piers need to be repaired to provide resistance against rotation of the gatehouse about the center pier.

During the inspection the two 30-inch by 30-inch gates were operated by use of the gasoline engine which was started by a hand crank. The engine started without difficulty and the gates were partially opened and then closed. An indicator was noted on the wall of the gatehouse indicating the position of the gates. Inspection of the gate stems indicate that stem guides are mounted on the concrete center pier which supports the gatehouse. Since the center pier has tipped toward the reservoir, the stem guides are now causing the gate stems to bind. It appears that the stem guides have been modified in the past to compensate for the tipping of gatehouse pier; however, additional movements of the pier (1 to 2 inches) have occurred subsequently. During closing of the gates, the gatehouse lifted off the center pier. The 36-inch by 36-inch gates were observed from the conduit outlets at the downstream face of the dam. Both gates were leaking along their perimeters, with most of the leakage being at the tops of the gates. The gate leakage was estimated at about 1 cfs. (An underwater inspection report describing the gates and trash rack at the head of the stone conduit is included in Appendix B.)

Leakage through the roofs of the two stone conduits was noted at a point 2½ feet from the downstream face of the dam. According to record plans the area of leakage corresponds to where the 1888 work jointed against the original 1866 structure. This leakage condition requires further investigation to determine if it is related to the shallow depression above in the pavement of Falland Road. Repairs will be necessary if the leakage is causing internal distress in the dam. The horizontal and vertical alignment of the two stone conduits is good.

Beyond the downstream face of the dam, the discharge channel for the two outlets is contained between two stone retaining walls. The width of the discharge channel between the two retaining walls is 16 feet. The left, retaining wall is partially collapsed. (See Appendix C, Photo-graph 1.) This retaining wall should be repaired since further collapse could result in blockage of the discharge channel. Other obstructions such as boulders and overhanging trees should be removed from the channel.

150 feet to the northeast. Some of the seepage is the result of water passing through the joints in the cut stone masonry (see Appendix C, Photograph 9). This downstream seepage condition should be monitored and investigated further. Consideration should also be given to the feasibility of a drainage system to allow seepage to be collected and monitored.

There is no riprap or other means of erosion control at the downstream toe of the dam which would protect the base of the dam during periods when emergency spillway flow might occur. It is not known if the entire length of the stone masonry at the downstream face rests on ledge. In any event the earth banked against the downstream stone masonry face adds additional resistance to sliding and forward movement of the stone masonry, and should therefore be protected against erosion which could be caused by emergency overflow.

Pavement on the top of the dam extends only for the width of Tolland Road. Pavement should be constructed to cover the entire width of the dam for at least 300 feet (within the emergency spillway section). The pavement should be designed to prevent flow of water under the pavement during emergency overflow.

The principal spillway (see Appendix C, Photograph 8), is a stone masonry overflow which is founded on bedrock. The stone masonry crest is approximately 6 feet high at its northeast end, and approximately 4 feet high at its southwest end. The spillway has a total length of 38 feet and is divided in equal lengths by a 2 foot wide stone masonry and concrete pier as can be seen in Photograph 8.

The endwalls of the spillway serve as abutments to a steel stringer bridge (Tolland Road). The bottom of the steel stringers are 7.3 feet above the crest of the stone masonry spillway. There are 10 stringers, 12 inches deep, 2.5 feet on center, which are covered with steel bridge decking and bituminous concrete pavement. Concrete surrounds the ends of the stringers at both abutments. The stringers appear continuous over the center pier. The stringers and steel decking are rusted and should be scraped and painted.

Water approaches the spillway crest through the bridge opening. The floor of the bridge opening (approach channel) is comprised of gravel and cobbles with no obstructions noted. The stone masonry spillway has a single 1" thick plank flashboard about 1 foot high. The ends of the flashboard are anchored in slots (32 inches high) as can be noted in Photograph 8. One inch diameter steel pipes about 2½ feet apart along the stone masonry spillway crest provide intermediate support for the flashboard. No notches were visible in the steel pipe flashboard pins, which would insure that the pins would yield. The upstream face of the spillway and flashboard were covered with a plastic membrane, presumably for leakage control. There is evidence that the stone masonry spillway has been repaired as noted by an area of formed concrete at the face of the spillway near its northeast end.

Steel beam guard rails with steel posts are located at each side of Tolland Road including across the spillway bridge.

SECTION 3
VISUAL INSPECTION

3.1 FINDINGS

a. General

Otis Reservoir Dam was inspected on June 11, 1980. The weather was clear and sunny. The water level of the reservoir was at elevation approximately 1419.7 or about 2 inches below the flashboard crest. The entire downstream face and toe of the dam and spillway were visible during the inspection. The upstream face could only be viewed above the noted water level. (Appendix C, Photograph 2 shows the upstream face of the dam, gate house and gates, while the reservoir was drawn down in 1956.) During the inspection, the gasoline engine was started and the gates were operated by the Department of Forest and Parks personnel. The two 30-inch by 30-inch gates were observed from the outlets of the stone conduits at the downstream face of the dam.

b. Dam

The earth embankment section and cut stone masonry at the downstream face of the dam appear in generally fair condition. The horizontal and vertical alignment of the stone masonry face is good and all of the stone blocks appear stable (see Appendix C, Photograph 6). Small brush and grass was noted growing through the joints in the stone masonry on the downstream face. This should be removed as part of the routine maintenance.

The pavement for Tolland Road, which passes over the dam, is in good condition. During inspection of the two 30-inch by 30-inch stone conduits, it was noted that concentrated leakage is occurring through the tops of the conduits at a location approximately 20 feet from the downstream face of the dam. The area of this leakage corresponds roughly to a slight depression in the pavements, as evidenced by the puddles of surface water in Appendix C, Photographs 1 and 3. This condition requires further investigation to determine if there is any relationship between the leakage through the roofs of the conduits and the depression in the roadway.

According to available plans and correspondence on file with the Berkshire County Commissioners, the top of the dam was designed in 1888 to act as an emergency spillway during high flows. A survey of the dam crest made in 1956 indicated that the road had been raised during subsequent years due to fill being added to the bed of Tolland Road which passes over the dam. A plan dated June 1956 by W. A. Heaphy was the basis of the regrading work done after the 1955 flood to restore the top of dam elevation to the 1888 design grades. Measurements made during the Phase I Inspection indicate that the present top of dam elevations correlate reasonably well with the elevations shown on the 1956 plan. Repaving has probably added about 0.2 feet to the crest elevation.

The downstream toe of the dam is an earth embankment against the cut stone masonry. Four seepage areas were noted at the downstream base of the dam between the low level outlet discharge channel, and a point approximately

Mr. Pearl Rote, the previous dam caretaker employed by the Farmington River Water Power Company presently lives in a state-owned building near the damsite but is not an employee of the Commonwealth and has no responsibility for the dam operation. Mr. Rote and his father were the caretakers of the dam for the Farmington River Water Power Company since before 1900.

2.4 EVALUATION OF DATA

a. Availability

Existing information was made available by the Massachusetts Department of Environmental Management; Massachusetts Department of Public Works, District 1; Division of Forest and Parks; and the Berkshire County Commissioners (William Heaphy, County Engineer).

b. Adequacy

The final assessments and recommendations of this investigation are based primarily on the visual inspection, hydraulic and hydrologic calculations, past performance history, and sound engineering judgment.

c. Validity

In general, the information obtained from available plans, specifications, correspondence and reports is consistent with observations made during the inspection and is therefore considered reliable.

SECTION 2
ENGINEERING DATA

2.1 DESIGN DATA

Plans dated 1887-88 show the original dam as constructed in 1866, and plans and specifications for modifications to the dam made in 1888, are on file with the Berkshire County Commissioners, Office of the County Engineer, Pittsfield, Massachusetts. The reservoir flowed over wetlands and three natural water bodies.

2.2 CONSTRUCTION DATA

Correspondence and reports of engineers covering the work done on the dam in 1888 are on file with the Berkshire County Commissioners. Plans dated 1956 for regrading of the top of dam are also on file with the Berkshire County Commissioners.

2.3 OPERATION DATA

The two 30-inch by 30-inch gates are operated as necessary to maintain a summer water level of approximately 1420 MSL. During the fall the gates are opened and the reservoir is drawn down approximately 8 feet to elevation 1412 MSL. Winter drawdown is done for the purpose of protecting docks from ice damage. The gates are raised and lowered simultaneously and automatically, using a gasoline engine which is equipped with a gear box. The engine is started with a hand crank. The gasoline engine is reportedly started at least once every week. The gates can also be operated manually with a hand wheel. At present the gates are not opened more than 25 inches because of the owner's concern that the gates might fall out of their slides. An indicator on the wall of the gate house shows the position of the gate. Because of the present structural condition of the gate house, closing of the gates too tightly will cause the gate house to lift off its pier.

In April of 1980, Massachusetts Department of Environmental Management (MDEM) requested an underwater inspection of the low level outlets and regulating gates. The underwater inspection was performed by the Massachusetts Department of Public Works (MDPW), Underwater Bridge Inspection Team. The divers' report is included in Appendix B.

The water level in the reservoir is observed on a gage board located on the northeast end of the concrete pier which supports the gate house. Elevation 25' - 4" on the gage corresponds to elevation 1419.9 which is the crest of the first flashboard on the spillway.

No stream gage or other flow measurement apparatus was observed at the damsite. However, the USGS maintains a stream gage downstream of the damsite 0.4 miles below the confluence of the Larkum Pond outlet. Brush is removed annually from the area near the downstream toe of the dam by MDEM personnel. MDEM personnel from the Tolland State Forest are used for maintenance and day-to-day operation and surveillance.

(2) Length of weir - 38 feet (total length divided in half by pier).

(3) Crest elevation - 1418.9 MSL without flashboards. 1419.9 MSL with present 12" high flashboard (stone slots available for 32" of flashboard height). Note: USGS shows water surface at el. 1421 MSL which is within about 1 foot of elevation given on plan dated 1956, on file with Berkshire County Commissioners.

(4) Gates - none on spillway.

(5) U/S Channel - Otis Reservoir. Spillway is beneath bridge which carries Tolland Road over dam.

(6) D/S Channel - natural channel in bedrock; steep slope.

j. Regulating Outlets

(1) Invert - 1391 (outlets).

(2) Size - 2 low level outlets 30" by 30", combined capacity of 360 cfs @ 1427.1 MSL.

(3) Description - Outlets are stone conduits through the dam. (See Appendix C, Photograph 5.) Conduit length is approximately 63 feet divided by stone block septum.

(4) Control mechanism - Two gate operators mounted on flood stands. Gates can be operated by a gasoline engine which is equipped with a gear box, or they can be opened by hand wheels. An indicator on the wall of gate house shows the position of gates. An automatic control shuts off the gasoline engine when gates reach a certain height. The gates bear the marking: Coffin Valve Co., Boston, Massachusetts, date August 8, 1923.

(5) Other - Inlets of low level outlets have wooden trash rack. (See Appendix C, Photograph 2, taken in 1956.)

e. Storage (acre-feet)
(1) Normal pool - 22,000 with flashboard

(2) Flood control pool - not applicable.

(3) Spillway crest pool - 22,000.

(4) Top of dam - 24,600.

(5) Test flood pool - 29,900.

f. Reservoir Surface (acres)
(1) Normal pool - 1,000.

(2) Flood control pool - not applicable.

(3) Spillway crest pool - 1,000.

(4) Top of dam - 1,050.

(5) Test flood pool - 1,180.

g. Dam (no dike)
(1) Type - composite earth and stone masonry/gravity.

(2) Length - 630 feet.

(3) Height - 31.5 feet.

(4) Top width - 30 feet.

(5) Side slopes - 2H: 12V, downstream masonry; 3H:1V, upstream embankment.

(6) Zoning - cut stone masonry with mortar joints on front face; earth fill behind stone masonry.

(7) Impervious core - type of earth fill, unknown.

(8) Cutoff - unknown.

(9) Grout curtain - unknown.

(10) Other - steel stringer bridge over spillway.

h. Diversion and Regulating Tunnel - not applicable (see j.)

i. Spillway
(1) Type - cut stone masonry with mortar joints. Spillway weir has 12" high flashboard above masonry crest.

(7) Total spillway capacity at test flood elevation - 2600 cfs @ 1427.1 MSL (without flashboards - not including flow over top of dam).

(8) Total project discharge at top of dam - 1100 cfs @ 1422.5 MSL. (Includes discharge of 2 regulating gates plus ungated spillway without flashboards.)

(9) Total project discharge at PMF test flood elevation - 11,900 cfs @ 1427.1 MSL (without flashboards).

(10) Total project discharge at ½ PMF elevation - 4200 cfs @ 1424.8 MSL (without flashboards).

c. Elevation (Datum is feet above mean sea level NGVD referred to in text as MSL)

(1) Streambed at toe of dam - 1391.

(2) Bottom of cutoff - unknown.

(3) Maximum tailwater - unknown.

(4) Normal pool - 1420 according to plan available with Berkshire County Commissioners; 1421 by USGS Quadrangle.

(5) Full flood control pool - not applicable.

(6) Spillway crest - 1418.9 without flashboard
1419.9 with flashboard.

(7) Design surcharge (Original Design) - about 1423.

(8) Top of dam - 1422.5 (low point).

(9) PMF test flood surcharge - 1427.1.

(10) ½ PMF surcharge - 1424.8.

d. Reservoir (length in feet)

(1) Normal pool - 18,000.

(2) Flood control pool - not applicable.

(3) Spillway crest pool - 18,000.

(4) Top of dam - 18,400.

(5) Test flood pool - 19,200.

1.3 PERTINENT DATA

a. Drainage Area

The total drainage area contributing to Otis Reservoir is 16.0 square miles. The drainage area is oriented with its long axis in a north-south direction; and is northerly limit extends to the area of the Massachusetts Turnpike in the Town of Becket. The watershed has a length of approximately 8 miles and an average width of approximately 2 miles. The basin is covered by forests and wetlands, and a large percentage of open water. Open water wetlands comprise about 50% of the watershed. The remainder of the watershed is rolling, wooded, terrain. Elevations in the watershed range from 1420 MSL at Otis Reservoir to 1799 MSL at the northerly fringe.

The northern half of the drainage area lies above Route 23 and drains through Big Pond. Big Pond is a shallow body of water having a surface area of about 330 acres, and a normal water surface elevation of 1472. The surface level of Big Pond is controlled by a 2 foot high, 90 foot long concrete weir structure shown in Appendix C, Photograph 13.

The southern half of the watershed (south of Route 23) consists of uncontrolled areas draining directly into Otis Reservoir.

b. Discharge at Damsite

Discharges at the damsite are over the 38 foot long stone masonry spillway which has one wooden flashboard at its crest, and through two 30-inch by 30-inch low level outlets. According to a 1956 plan on file with the Berkshire County Commissioners, the crest of the stone masonry spillway is at elevation 1418.9. The top of the wood plank flashboard is about elevation 1419.9. When the water level reaches approximately elevation 1422.5, water begins to flow over Tolland Road which has been graded to provide a 260 foot long emergency spillway.

(1) Outlet works - two 30-inch by 30-inch low level outlets at elevation 1391; combined discharge capacity 330 cfs @ 1422.5 MSL.

(2) Maximum flood at damsite - unknown. Water either overtopped the dam or was very near to the top of dam in 1955. The dam was lowered by about 1.5 feet after the 1955 flood.

(3) Ungated spillway capacity at top of dam - 450 cfs @ 1422.5 MSL, with flashboards; 780 cfs without flashboard.

(4) Ungated spillway capacity at test flood elevation - 2600 cfs @ 1427.1 MSL (without flashboards - not including flow over top of dam.)

(5) Gated Spillway capacity at normal pool elevation - not applicable.

(6) Gated spillway capacity at test flood elevation - not applicable.

by the Commonwealth of Massachusetts in 1967. The dam impounds Otis Reservoir which is now used for recreation. Tolland State Forest is located approximately 1 mile south of the damsite.

g. Design and Construction History

According to records on file with the Berkshire County Commissioners, the dam was originally built in 1866 by the Farmington River Water Power Company (FRWPC). The dam was modified by the FRWPC in 1888 in order to strengthen the dam. Work completed in 1888 included construction of a grouted stone masonry wall over the downstream face of the original dam, reconstruction of the stone masonry spillway, and grading of the top of the dam so that emergency spillway action would occur at higher flows. Designs for the 1888 repairs were prepared by William Hill, Engineer for the Farmington River Water Power Company. Plans and Specifications, and subsequent modifications were submitted to and approved by the Commissioners of Berkshire County. The Commissioners retained Engineer D.M. Greene to advise on the plans.

Plans, specifications, and various correspondence relative to the 1888 work are presently in the files of the Berkshire County Commissioners in Pittsfield, Massachusetts.

After Hurricane Diane in 1955, the FRWPC lowered the dam by regrading Tolland Road to remove fill which had been placed over the dam in years subsequent to 1888.

A plan for regrading, on file with the Berkshire County Engineer dated June 1956, calls for lowering of the top of dam by approximately 1.5 feet for a length of about 275 feet. The top of the dam was set at elevation 1422.3 for a length of approximately 260 feet ot act as an emergency spillway which is 3.4 feet above the stone masonry crest of the spillway. Measurements taken at the site indicate that the work called for on the 1956 plan was done. Repaving work over the last 20 to 25 years has probably raised the grade slightly so the low point now is at 1422.5 MSL.

Repairs were also made in 1956 to the stone block dividing wall (septum) between the two 30-inch stone conduits. This repair work included anchoring one of the stones which was dislodged. The stone block was repositioned and anchored with metal straps. (See 1980 MDPW Underwater Inspection Team Report in Appendix B.)

h. Normal Operating Procedures

The two 30-inch gates are utilized to maintain a summer water level of approximately elevation 1420. A gage board on the pier of the gate house is used as a reference mark. Elevation 25' - 4" on the gage is equivalent to elevation 1419.9 which is the elevation of the top of the first flashboard on the spillway.

During October and November the regulating gates are opened to draw down the reservoir to approximate elevation 1412 so that docks along the reservoir will not be damaged by ice. The drawdown also allows for flood storage during the spring runoff period.

other records the dam was originally constructed in 1866. The dam was modified in 1888 for the purpose of strengthening the original dam according to records on file at the Berkshire County Commissioners' office.

A stone masonry spillway with a single flashboard is located near the southwest end of the dam. The spillway has a weir length of approximately 38 feet divided in half by a stone masonry and concrete pier which supports a steel stringer bridge above. (See drawings in Appendix B-3.)

The top of the dam is graded so that 40 percent of the crest may act as an emergency spillway during high flows. Water may rise approximately 3.6 feet over the stone masonry spillway weir (2.6 feet over flashboard) before flowing over the dam.

Two 30-inch by 30-inch stone conduits through the dam serve as a low level outlet for the reservoir. According to the records on file with the Berkshire County Commissioners, the stone blocks making up the conduits are connected with steel rods. Two sluice gates at the upstream end of these two stone conduits are used as regulating gates to control the water level of the reservoir and to partially draw the reservoir down during the winter. The two gates are normally operated with a Wisconsin gasoline engine with a gear box and chain drive. The gates may also be raised and lowered manually. The gate operators, gasoline engine and gear box, are located in an 18 foot by 20 foot wood-framed building which is balanced on a single center pier. The gate stems are attached to the upstream side of the center concrete pier and extend up into the floor of the wooden gate house. Photograph 2 in Appendix C shows the gate house and gates with the reservoir drawn down in 1956. A wooden trash rack is located upstream of the inlets to the two stone conduits as can be seen in Photograph 2.

c. Size Classification

Intermediate (hydraulic height 31.5 feet; storage 24,600 Ac. Ft.) based on storage (1000 to 50,000 Acre Feet) as given in the Recommended Guidelines for Safety Inspection of Dams.

d. Hazard Classification

The dam is in a high hazard category because of major breach of the dam could cause appreciable damage to roads and bridges in the downstream area. Loss of more than a few lives would be likely. The village of New Boston lies on the West Branch of the Farmington River about 5 miles downstream of the damsite. (See Section 5.5.)

e. Ownership and Operator

The dam is owned by the Commonwealth of Massachusetts, Department of Environmental Management. The day-to-day operation of the dam is assigned to an Regional Forest and Park Supervisor: Mr. Douglas Poland, Pittsfield State Forest, Cascade Street, Pittsfield, MA 01201, Telephone: (office) 413-442-8992, (Home) 413-623-8348.

f. Purpose of Dam

The dam was formerly owned by the Farmington River Water Power Co. and was used to regulate flow to downstream mills. The dam and reservoir were purchased

SECTION 5
EVALUATION OF HYDRAULIC/HYDROLOGIC FEATURES

5.1 GENERAL

The total drainage area contributing to Otis Reservoir is 16.0 square miles. The watershed has a length to width ratio of roughly 2 to 1.

Open water and wetlands comprise about 50% of the watershed. The remainder of the watershed is rolling wooded terrain. Elevations in the watershed range from 1420 MSL at Otis Reservoir to 1799 MSL at the northerly fringe.

The northern half of the drainage area lies above Route 23 and drains through Big Pond. Big Pond is a shallow body of water having a surface area of about 330 acres, and a normal water surface elevation of 1472. The surface level of Big Pond is controlled by a 2 foot high, 90 foot long concrete weir structure shown in Appendix C, Photograph 13.

The southern half of the watershed (south of Route 23) consists of uncontrolled areas draining directly into Otis Reservoir.

5.2 DESIGN DATA

The original dam at Otis Reservoir was constructed in 1866 and was later modified in 1888. According to flow data on the record plans, the design capacity of the spillway was 840 cfs with a head of 4 feet. The design discharge capacity of the low-level outlets was 320 cfs at "full pond". Water flowing over the dam at a depth of 1 foot for a length of about 125 feet was intended to pass 414 cfs, thus the total design discharge capacity appears to have been 1574 cfs.

5.3 EXPERIENCE DATA

According to the former gate keeper for the Farmington River Water Power Company and Division of Forest and Parks personnel, Hurricane Diane, in August 1955, caused water to rise near or above the level of the top of the dam which was approximately 1.5 feet higher than the present top of dam elevation.

Since 1969, the U.S. Geological Survey has maintained stream gage Number 01185100 0.4 miles downstream of Otis Reservoir on the Fall River below the confluence of the Larkum Pond outlet (drainage area, 16.5 square miles). (Note: The location of the stream gage is incorrectly shown at the dam on the USGS Quadrangle.) The maximum recorded discharge during the period of record occurred in 1972 with a flow of 422 cfs.

5.4 TEST FLOOD ANALYSIS

Otis Reservoir Dam is classified as intermediate size, having a hydraulic height of 31.5 feet and a top of dam storage of 24,600 acre feet. The dam was determined to have a high hazard classification. Using the Recommended Guidelines for Safety Inspection of Dams, the test flood is the Probable Maximum Flood (PMF).

The Probable Maximum Flood (PMF) was estimated using methods contained in Preliminary Guidance for Estimating Maximum Probable Discharges in Phase I Dam Safety Investigations, issued by the New England Division Corps of Engineers. (CSM value of 1100 cfs per square mile was selected midway between curve for flat terrain and rolling terrain.)

The PMF test flood inflow from the square mile drainage area was estimated to be 17,600 cfs. Storage effects would reduce the test flood inflow to a routed test flood outflow of approximately 11,900 cfs.

During test flood conditions water would rise to elevation 1427.1 which is about 4.6 feet above the top of dam. Water would be passing over the spillway at a depth of 8.2 feet, and would amount to 2,600 cfs. The combined capacity of the spillway (without flashboards), and the two 30-inch low level outlets, with water at the top of the dam (1422.5 MSL) is 1100 cfs which is 9 percent of the routed test flood outflow. The ½ PMF was also estimated and it was found that during this event, water would rise to elevation 1424.8, or about 2.3 feet above the top of dam. The ½ PMF routed outflow at the damsite is estimated to be 4,200 cfs.

In both analyses it is assumed that the two 30-inch gates are open and are discharging freely. It is also assumed that the flashboard pins yield on the principal spillway. The pool level at the start of the reservoir routing was assumed to be 1420 MSL.

Based on available plans the PMF test flood surcharge exceeds the design surcharge (elevation 1423 approximately), by about 4 feet and the ½ PMF surcharge exceeds the design surcharge by approximately 2 feet.

5.5 DAM FAILURE ANALYSIS

The impact of failure of the dam was assessed using Corps of Engineers "Rule of Thumb" Guidance for Estimating Downstream Dam Failure Hydrographs. The estimate assumes:

(a) the reservoir surface is at the top of the dam at the time of the breach, and

(b) a breach of 40% of the dam length at mid-height occurs (120 feet).

The estimated discharge resulting from the breach would be approximately 34,000 cfs. At a section 400 feet downstream of Larkum Pond the breach would cause a flood-wave height of about 17 feet. Water would also probably back up into Larkum Pond, possibly flooding Camp Nawaka. The twin 72-inch culvert crossing at Reservoir Road would be washed out. A new home in the area of

this culvert crossing would probably be destroyed. The flood-wave would meet the West Branch of the Farmington River and possibly back upstream for a distance towards the Town of Otis. The major damage center would be in the village of New Boston (including Roosterville), where 10 to 15 structures could be flooded at depths of 3 to 6 feet. At the Route 8 bridge near the junction of Route 57, in New Boston, water would be 6 or 7 feet over the road at this point. There would be no flooding of the West Branch of the Farmington River by flows occurring prior to the assumed breach.

A major breach of the dam could cause appreciable damage to roads and bridges in the downstream area and loss of more than a few lives would be likely. Therefore, Otis Reservoir Dam was classified as <u>High Hazard</u>.

Below the village of New Boston the floodplain of the West Branch of the Farmington River widens out before the river enters the flood storage area for the Colebrook Flood Control Reservoir. The Colebrook Reservoir is a U.S. Corps of Engineers flood control project, constructed in the late 1960's. Colebrook has a flood storage capacity of 50,800 acre-feet, and a design spillway capacity of 96,000 cfs.

SECTION 6
EVALUATION OF STRUCTURAL STABILITY

6.1 VISUAL OBSERVATIONS

The most significant visual observation related to the structural aspects of this dam is the leakage observed through the roofs of the two 30-inch by 30-inch stone conduits. It is unknown if the shallow depression in the pavement on Tolland Road is related to this leakage. This leakage should be investigated and monitored to determine if fines are being washed out of the earth embankment. Seepage at the base of the dam should also be monitored.

Other deficiencies are described in Section 3. Recommendations to improve these deficiencies are given in Section 7.

6.2 DESIGN AND CONSTRUCTION DATA

No design computations pertaining to the structural stability of the dam have been located. Plans and Specifications for the 1888 modifications to the dam are on file with the Berkshire County Commissioners. The specifications describe the original 1866 structure and give the dimensions of the original structure. The specifications state that the 30-inch stone conduits were part of the original dam and that the stone blocks making up the conduits were "doweled together with iron bolts".

6.3 POST-CONSTRUCTION CHANGES

Plans and Specifications for the 1888 modifications to the dam are on file with the Berkshire County Commissioners. A 1956 plan and specifications for regrading and paving Tolland Road (top of dam) are also on file with the Berkshire County Commissioners.

6.4 SEISMIC STABILITY

The dam is located in Seismic Zone No. 2, and in accordance with Recommended Phase I guidelines does not warrant seismic analysis.

SECTION 7
ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Condition

Based on engineering judgment and the past performance of the dam and outlet works, the project appears to be in fair condition. The project, however, does have inadequacies and deficiencies which, if not remedied, have the potential for developing into hazardous conditions.

b. Adequacy of Information

Available data cited in previous sections were reviewed, including previous inspection reports and the 1980 report of the Massachusetts Department of Public Works Underwater Bridge Inspection Team. There is no detailed information concerning the fill used for the earth embankment, nor is there any available data regarding subsurface conditions at the damsite.

c. Urgency

The recommendations made in 7.2 and 7.3 should be implemented by the owner within one year after receipt of this Phase I Inspection Report, except as noted.

7.2 RECOMMENDATIONS

The owner should engage a qualified Registered Professional Engineer to:

(1) Perform a detailed hydrologic and hydraulic analysis to determine the need for and methods to increase project discharge capacity.

(2) Design a new supporting system for the gate house so that the structure is stable and well-anchored against movements during operation of the gates, and during emergency overflow.

(3) Design guide mechanisms for the two 30-inch by 30-inch gates to insure that gates cannot leave tracks during opening and closing.

(4) Design protection for the downstream toe of dam to prevent washout at the base during emergency overflow. Pavement of the entire top width of the dam should be designed so that erosion of the top will be prevented during emergency overflow.

(5) Investigate and monitor the leakage through the roofs of the two 30-inch by 30-inch stone conduits. Repairs should be designed as necessary. This should be done immediately upon receipt of this report.

(6) Investigate and monitor the seepage at the toe of the downstream face of the dam. A collection system with a measuring weir should be designed.

(7) Investigate the impact of flashboards on the stability of the masonry weir and masonry pier.

(8) Design repairs to the retaining wall for the low-level outlet discharge channel.

The owner should carry out the recommendations and designs made by the Engineer..

7.3 REMEDIAL MEASURES

a. Operation and Maintenance Procedures

The owner should:

(1) Establish a formal written operational and maintenance program including an annual comprehensive technical inspection by a qualified Registered Professional Engineer.

(2) Establish a formal written surveillance and downstream warning (emergency preparedness) plan.

(3) Remove grass and brush growing in the joints of the stone masonry in the face and top of the dam.

(4) Cut trees and brush for at least 50 feet beyond the downstream toe of the dam to allow for access and observation.

(5) Clear discharge channels for low-level outlet and spillway of debris and overhanging trees. The remains of steel screens and footbridge for the downstream fish trap should be removed.

(6) Scrape, sandblast and paint stringers for bridge over spillway.

7.4 ALTERNATIVES

There are no practical alternatives to the above recommendations.

APPENDIX A

VISUAL INSPECTION CHECKLIST

VISUAL INSPECTION PARTY ORGANIZATION

NATIONAL DAM INSPECTION PROGRAM

DAM: Otis Reservoir Dam MA 00308

DATE: 11 June 1980

TIME: 8:45 a.m.

WEATHER: Clear/Sunny

W.S. ELEV. 1419.7 U.S. 1391.5 DN.S.

ELEV. DATUM: Elevation of stone masonry spillway - 1418.9 MSL. Taken from 1956 Plan by W. A. Heaphy entitled "Plan and Profile of Otis Reservoir Dam"

INSPECTION PARTY:

1. J. F. Cysz, P.E.
2. K. N. Hendrickson, P.E.
3. J. E. Walsh, P.E. (Baystate Environmental Consultants, Inc.)
4. L. D. Zwingelstein
5. H. T. Shumway
6. _____

All project features inspected by all party members.

OTHERS PRESENT DURING INSPECTION:

1. William Sawtell - Division of Forest and Parks
2. Melody O'Brien - Division of Forest and Parks
3. Pearl Rote - Former Gatekeeper for the Farmington River Water Power Company
4. _____

VISUAL INSPECTION CHECKLIST

DAM: Otis Reservoir Dam MA 00308 DATE: June 11, 1980

AREA EVALUATED	CONDITION
DAM EMBANKMENT	Composite earth embankment and stone masonry.
Crest Elevation	1422.5 MSL at low point - was 1.5' higher prior to 1955.
Current Pool Elevation	1419.7 MSL.
Maximum Impoundment to Date	1955 - overflow of old road, or very near to overflow.
Surface Cracks	Crest is roadway - Tolland Road - no serious cracking noted.
Pavement Condition	Good
Movement or Settlement of Crest	Depression near center of dam (see photograph showing puddle of surface water).
Lateral Movement	None detected.
Vertical Alignment	Low point by design - see profile in Appendix B.
Horizontal Alignment	Good.
Condition at Abutment and at Concrete Structures	Stone masonry okay at spillway bridge abutments; no structures at abutments; dam blends to natural ground.
Indications of Movement of Structural Items on Slopes	Piers at gate house out of plumb and alignment.
Trespassing on Slopes	Not applicable.
Vegetation on Slopes	Small brush and grass growing in stone masonry face at d/s and crest.

VISUAL INSPECTION CHECKLIST

DAM: Otis Reservoir Dam MA 00308 DATE: June 11, 1980

AREA EVALUATED	CONDITION
DAM EMBANKMENT (cont'd.)	
Sloughing or Erosion of Slopes or Abutments	None detected. Crest of dam should be fully paved to protect against emergency overflow.
Rock Slope Protection - Riprap Failures	Okay on upstream face.
Unusual Movement or Cracking at or near Toes	Open joints in stone masonry.
Unusual Embankment or Downstream Seepage	Seepage noted at base of stone masonry - see sketch in Appendix B - should be monitored.
Piping or Boils	None other than seepage.
Foundation Drainage Features	None
Toe Drains	None
Instrumentation System	None

VISUAL INSPECTION CHECKLIST

DAM: Otis Reservoir Dam MA 00308 DATE: June 11, 1980

AREA EVALUATED	CONDITION
OUTLET WORKS - INTAKE CHANNEL & INTAKE STRUCTURE	Not visible - see Appendix B, report of MDPW Underwater Bridge Inspection Team. Also see Appendix C, Photograph 2.
a. Approach Channel	
Slope Conditions	
Bottom Conditions	
Rock Slides or Falls	
Log Boom	None
Debris	
Condition of Concrete Lining	
Drains or Weep Holes	
b. Intake Structure	
Condition of Concrete	
Stop Logs and Slots	

VISUAL INSPECTION CHECKLIST

DAM: Otis Reservoir Dam MA 00308 DATE: June 11, 1980

AREA EVALUATED	CONDITION
OUTLET WORKS - CONTROL TOWER	Note: Wooden gate house balanced over center pier - not bolted. Pier is out of vertical. Wood floor is poor in gate house and bridge.
a. Concrete and Structural	
General Condition	Poor - unstable.
Condition of Joints	No joints.
Spalling	Yes - piers poor.
Visible Reinforcing	Steel stringers rusted.
Rusting or Staining of Concrete	Rusting from steel stringers.
Any Seepage or Efflorescence	Not applicable to this structure.
Joint Alignment	Not applicable to this structure.
Unusual Seepage or Leaks in Gate Chamber	No gate chamber - gates won't seat - leakage as evidenced downstream.
Cracks	Not applicable to this structure.
Rusting or Corrosion of Steel	Rusting of steel stringers supporting gate house.
b. Electrical and Mechanical	I.C. Wisconsin engine with hand crank to start engine.
Air Vents	Muffler exhaust goes through floor.
Float Wells	Indicator on wall position of gates - no float well.
Crane Hoist	None - gates can be opened with hand wheels.
Elevator	None
Hydraulic System	None

VISUAL INSPECTION CHECKLIST

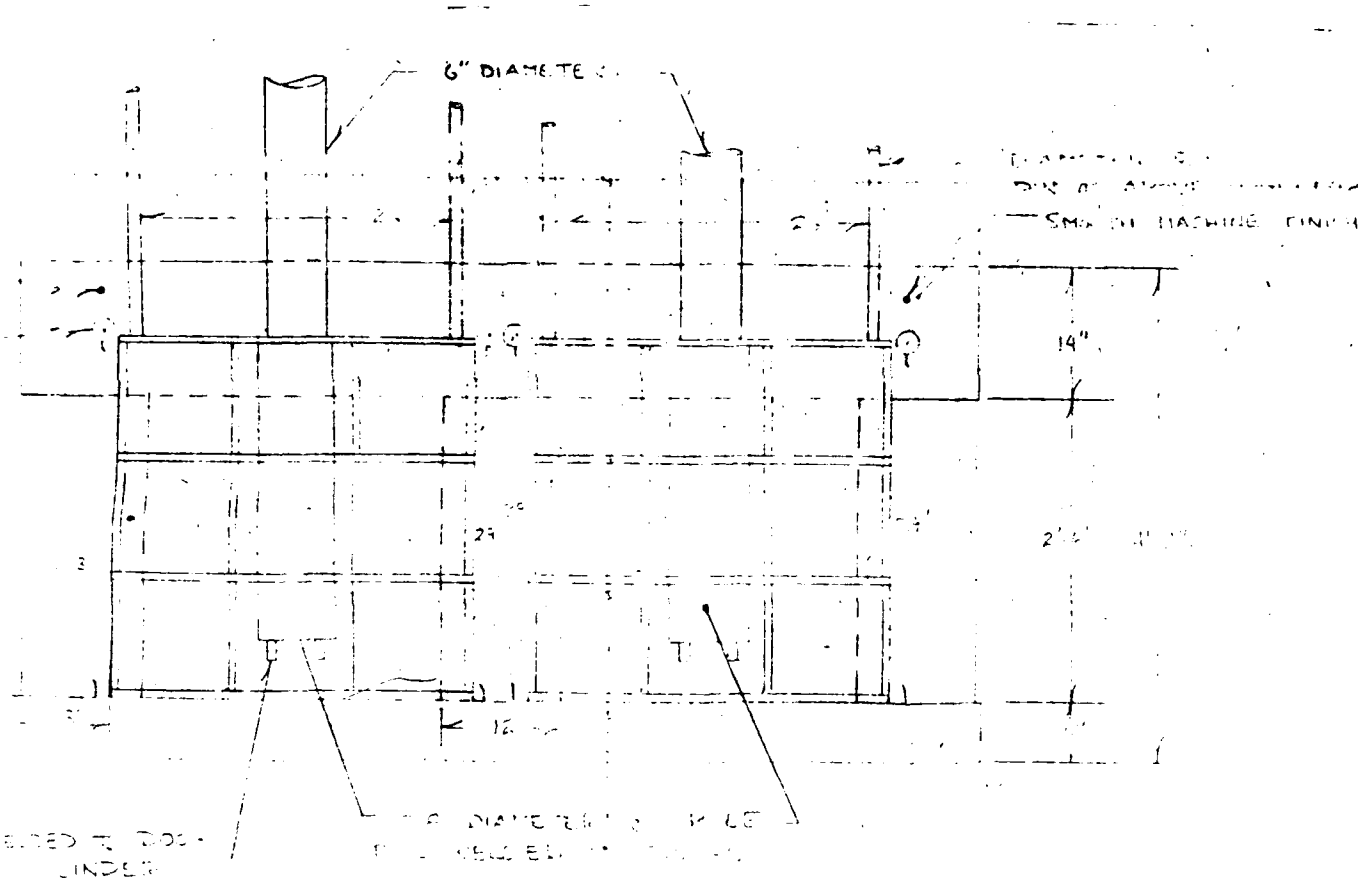
CAM: Otis Reservoir Dam MA 00308 DATE: June 11, 1980

AREA EVALUATED	CONDITION
OUTLET WORKS - CONTROL TOWER (cont'd.)	
Service Gates	Two 36" x 36" - used to regulate water elevation.
Emergency Gates	None - Stem guides binding due to movements in pier for gate house.
Lightning Protection System	None
Emergency Power System	None required; gates can be operated manually.
Wiring and Lighting System in Gate Chamber	OK. Lighting only.

VISUAL INSPECTION CHECKLIST

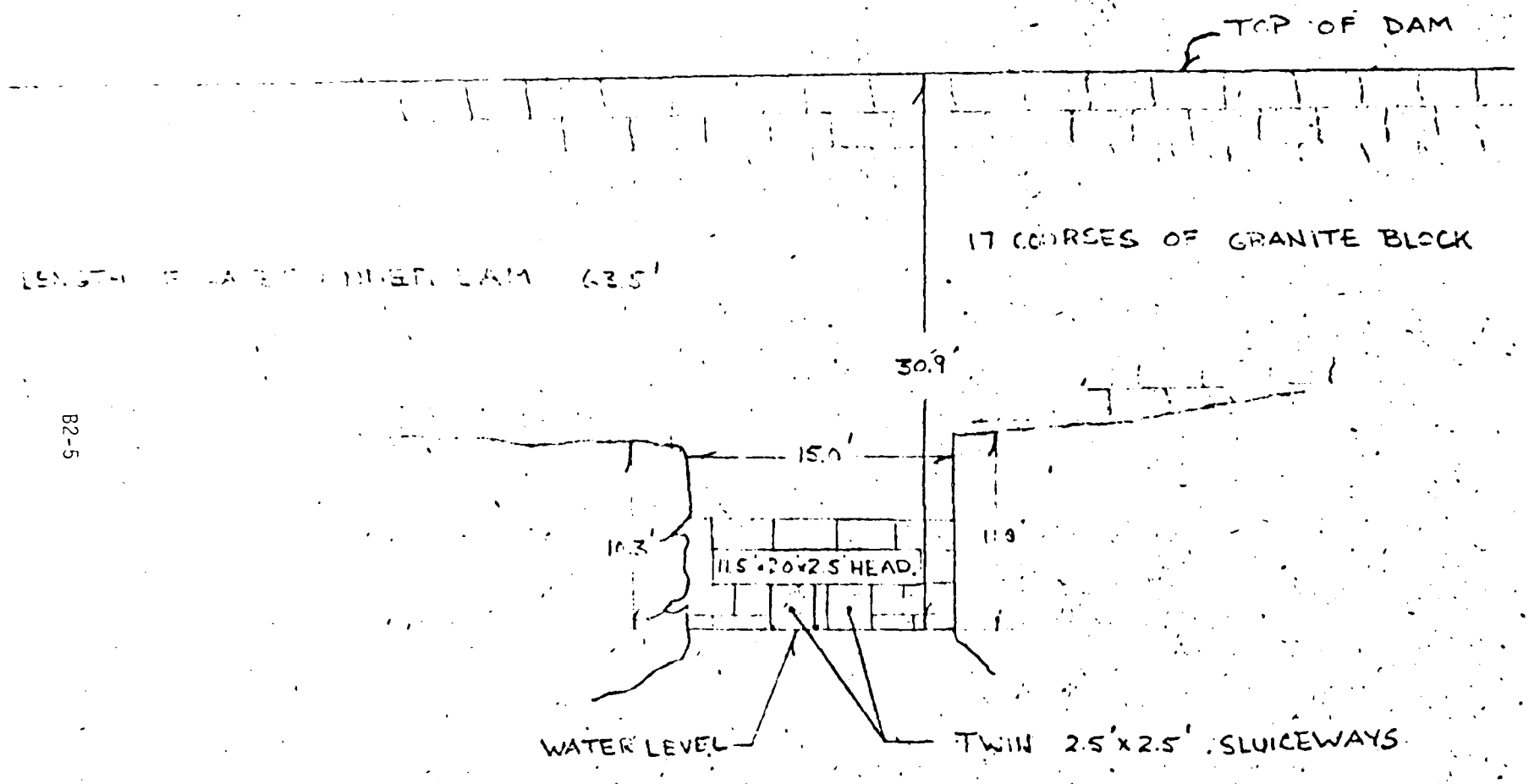
DAM: Otis Reservoir Dam MA 00308 DATE: June 11, 1980

AREA EVALUATED	CONDITION
OUTLET WORKS - TRANSITION AND CONDUIT	Note: Leaks down through roofs of stone conduit 20' upstream of conduit outlet.
General Condition of Concrete	Stone masonry conduits - not concrete.
Rust or Staining on Concrete	Not applicable.
Spalling	Not applicable.
Erosion or Cavitation	None detected
Cracking	None detected; one stone dislodged and repaired in 1956. Strapped with steel.
Alignment of Monoliths	Not applicable.
Alignment of Joints	Good alignment of stone conduits.
Numbering of Monoliths	Not applicable.



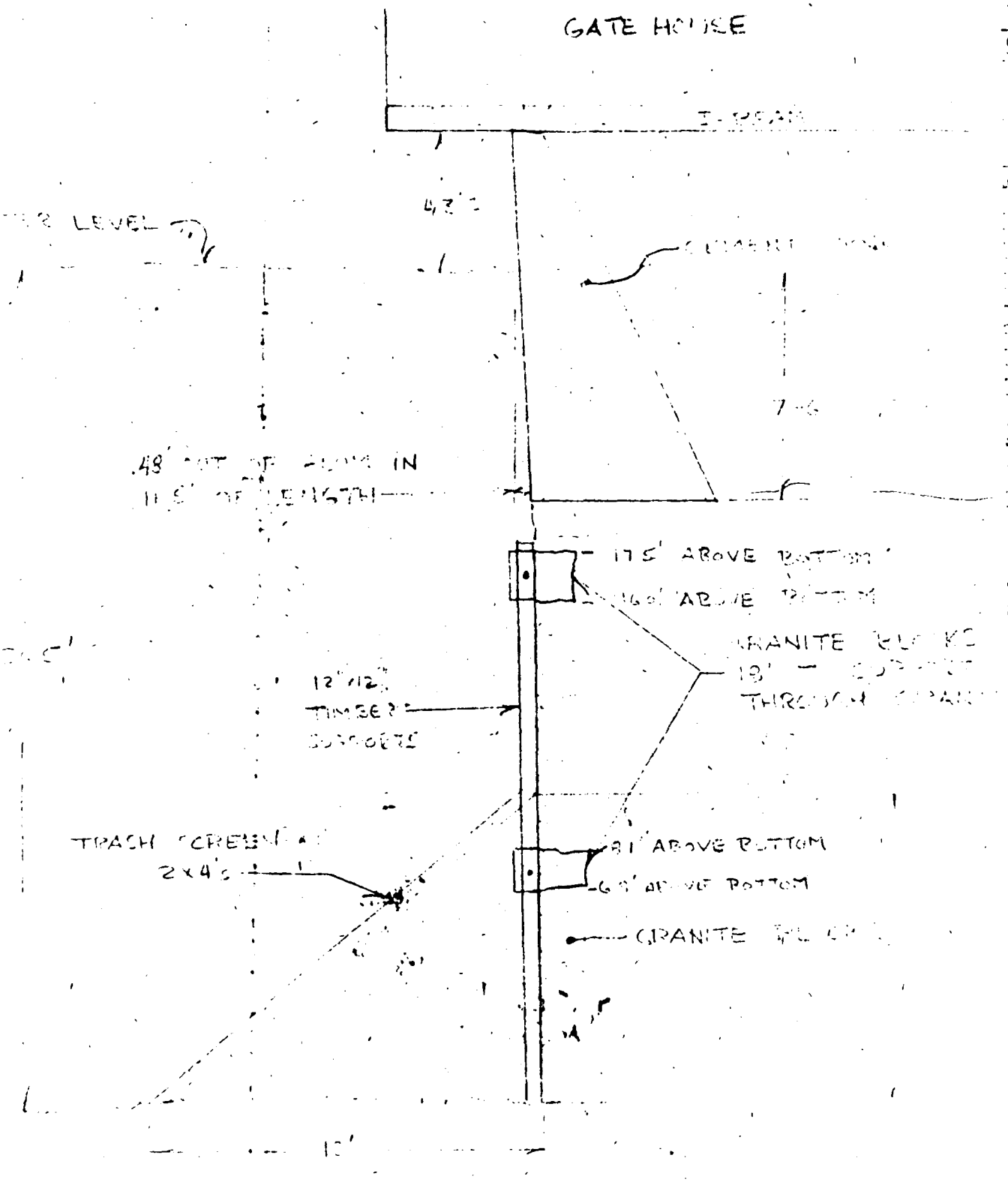
OTIS RES.

SLUICE GATE DETAIL

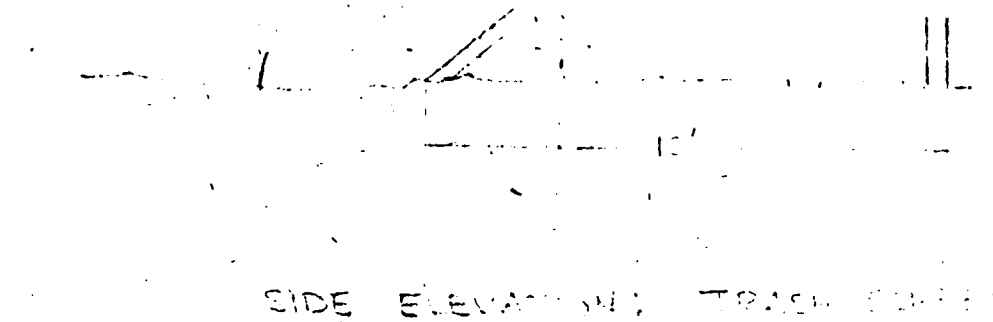


B2-5

ELEVATION: DAM FACE - DOWNSTREAM SIDE

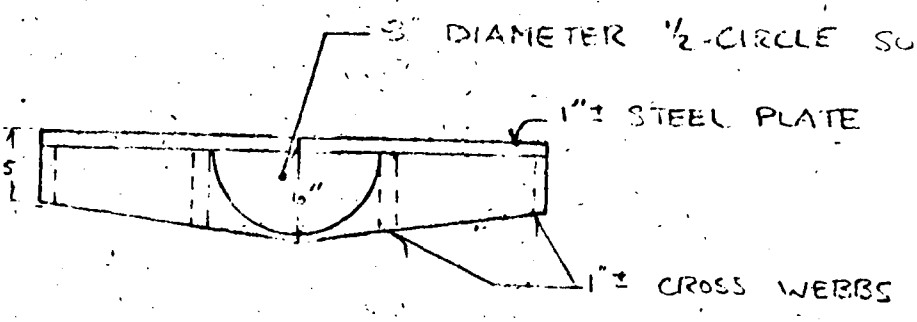


SIDE ELEVATION: TRASH SCREEN & GATE HOUSE



SIDE ELEVATION: TRASH RACK

HEADER STONE



TOP VIEW: GATE

NOTE: IT WAS ESTIMATED THAT A LEAKAGE OF 1.66 CFS WHEN FULLY CLOSED.

The seal is effected by the tight fit of the steel plate against the smoothly finished granite header and vertical supports.

When in a closed position the gates appear to be held in place primarily by water pressure. The only guides for the gates are four (4) three (3) inch diameter bronze wheels which are anchored to the leaderswith a steel rod at the top vertical edges of the gates.

The gates are seated flush on the invert with no apparent leakage. However there is some seepage at the sides and top.

A sketch of the gates is attached.

Sluiceways

The sluiceways which are constructed of granite block, were inspected from the downstream side of dam.

The dimensions are 63.5' long by 2.5' square.

There is a row of granite blocks which seperate the two (2) sluices. One block in this row (Six(6) feet from the gates) apparently shifted but was subsequently repaired. The six (6) steel straps which hold it in place are in good condition and the block appears secure.

The sluices are free of debris.

Attach.

JOSEPH P. DONAHUE
Diving Coordinator
Mass. DPW

DATE RECEIVED 4/16/80		
ROUTING		
RSH		
JMC		
JFC	✓	✓
GJF		
LDZ		
LLS		
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FILE		

Mass. Dept. of Public Works
Underwater Bridge Inspection Team

U/W Inspection Report
Sluice Gates at Dam/Tolland Road
Otis Reservoir, Otis
4/16/80

The Department of Environmental Management has the responsibility for the control of the water level of Otis Reservoir, Otis.

When the Reservoir is at capacity the water elevation is lowered by opening the Sluice Gates located at a dam on Tolland Rd. at the head of Southwest Bay.

The Operators of the dam experienced difficulty in closing the gates. DEM contacted our Department and requested an underwater inspection.

The following is the result of that inspection:

Trash Catcher

The Sluice gates are protected by a timber trash catcher which extends from ten (10) feet above to twelve (12) feet in front of the invert. The trash catcher is constructed of 2"X4" studs laid on edge and is twelve (12) feet in width. The sloping section of the structure appears to be in good condition.

The divers gained entry to the sluice gates by swimming beneath the trash catcher through its open sides.

Debris

A four (4) foot length of 2"X4" timber was wedged at a 45° angle against the northerly sluice gate. One end of the board was buried in the bottom, the other lodged into the reinforcing of the gate.

This timber probably caused the difficulty in the operation of the gate. It along with other wooden debris that was located beneath the trash catcher was removed.

Sluice Gates

There are two (2) seperate sluice openings which are each thirty (30) inches square.

The gates are thirty six (36) inches square and are constructed of one (1) inch thick steel plate which is reinforced with steel ribs.

PREVIOUS INSPECTION REPORTS

A. Massachusetts Department of Public Works, Underwater Bridge Inspection Team, report on Sluice Gates at Dam, dated April 18, 1980 - attached.

B. Inspections of dams were performed by the Massachusetts Department of Public Works, District 1, and reports are on file at District 1 Headquarters, Pittsfield-Lenox Road, Lenox, MA - Selected Reports attached.

C. Earlier inspections of dams were performed by the Berkshire County Engineer for the County Commissioners, and reports are filed at the County Engineer's office, County Court House, Pittsfield, MA - Selected Reports attached.

LIST OF AVAILABLE DESIGN

CONSTRUCTION AND MAINTENANCE RECORDS

A. PLANS AND SPECIFICATIONS - Plans and specifications for the original 1866 construction were not found, although 1887 plans and descriptions describe the as-built conditions. 1888 plans and specifications for modifications and improvements to the dam are also on file with the Berkshire County Commissioners, County Engineer's office, Berkshire County Court House, Pittsfield, MA 01201. A 1956 plan for regrading the top of dam is also on file with the County Commissioners.

B. DESIGN RECORDS - Descriptions filed with the County Commissioners of the 1888 work include some design data, but actual design records were not found.

C. CONSTRUCTION RECORDS - Some records filed with the County Commissioners.

D. MAINTENANCE - Recent maintenance records are on file at the offices of the Massachusetts Department of Environmental Management, Division of Forests and Parks, Pittsfield State Forest, Cascade Street, Pittsfield, MA 01201.

APPENDIX B

ENGINEERING DATA

B-1. LIST OF AVAILABLE DESIGN, CONSTRUCTION AND MAINTENANCE RECORDS

B-2. PREVIOUS INSPECTION REPORTS

B-3. PLANS, SECTIONS AND PROFILES

B-4. BORING LOGS

VISUAL INSPECTION CHECKLIST

DAM: Otis Reservoir Dam MA 00308 DATE: June 11, 1980

AREA EVALUATED	CONDITION
OUTLET WORKS - SERVICE BRIDGE (cont'd.)	
Approach to Bridge	Poor transition with pavement; gravel eroding behind abutment.
Condition of Seat & Backwall	No backwall. Seat okay. Concrete poured around ends of stringer.
	Note: Transverse cracks in pavement over bridge correspond to joints in bridge decking.

VISUAL INSPECTION CHECKLIST

DAM: Otis Reservoir Dam MA 00308 DATE: June 11, 1980

AREA EVALUATED	CONDITION
OUTLET WORKS - SERVICE BRIDGE	Includes Tolland Road Bridge over spillway.
a. Superstructure	
Bearings	None - stringers are used on masonry. Concrete was poured around ends of stringers.
Anchor Bolts	None visible.
Bridge Seat	Okay - stone masonry at abutments; concrete at center pier.
Longitudinal Members	Rusted - need maintenance 10 - 12" W F @ 2½ feet O.C.
Under Side of Deck	Steel decking rusted.
Secondary Bracing	3 sets of lateral braces need maintenance.
Deck	Steel deck rusted - has bituminous pavement on decking.
Drainage System	None - over side.
Railings	Okay - steel beam rail.
Expansion Joints	Filler type - ends only; stringers continuous over middle pier.
Paint	None - rusted.
b. Abutment & Piers	
General Condition of Concrete	Satisfactory.
Alignment of Abutment	Okay.

VISUAL INSPECTION CHECKLIST

DAM: Otis Reservoir Dam MA 00308 DATE: June 11, 1980

AREA EVALUATED	CONDITION
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS (cont'd.)	
Trees Overhanging Channel	Yes
Floor of Channel	Bedrock irregular and fractured; drops off 200' from weir.
Other Obstructions	Debris, stumps, fallen tree

VISUAL INSPECTION CHECKLIST

DAM: Otis Reservoir Dam MA 00308 DATE: June 11, 1980

AREA EVALUATED	CONDITION
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	Note: Water approaches spillway between abutments of bridge over spillway.
a. Approach Channel	
General Condition	Okay - one 12" wood flashboard with plastic membrane on upstream face of weir.
Loose Rock Overhanging Channel	None - riprap okay.
Trees Overhanging Channel	Not a problem - 30' upstream of bridge opening.
Floor of Approach Channel	Gravel and cobbles - okay.
b. Weir and Training Walls	Concrete poured over stone masonry at center pier.
General Condition of Concrete	Satisfactory - concrete has minor spalling at stone masonry interface at center pier.
Rust or Staining	Yes - from rusting bridge stringers above.
Spalling	No.
Any Visible Reinforcing	None
Any Seepage or Efflorescence	Masonry weir - minor seepage in joints of stone and around flashboards.
Drain Holes	None - formed concrete repair in face of spalling weir.
c. Discharge Channel	
General Condition	Natural - needs minor maintenance work.
Loose Rock Overhanging Channel	Yes

VISUAL INSPECTION CHECKLIST

DAM: Otis Reservoir Dam MA 00308 DATE: June 11, 1980

AREA EVALUATED	CONDITION
OUTLET WORKS - OUTLET STRUCTURE & OUTLET CHANNEL	2.5' x 2.5' stone conduits with stone block septum.
General Condition of Concrete	No concrete - cut stone masonry blocks
Rust or Staining	No
Spalling	Not applicable.
Erosion or Cavitation	None detected.
Visible Reinforcing	No - stones in conduits repaired - bolted together.
Any Seepage or Efflorescence	General seepage in face of dam in area of conduit outlets.
Condition at Joints	Mortar washed out of joints - mortar weathered; vegetation growing in joints.
Drain Holes	None - seepage through joints.
Channel	
Loose Rock or Trees Overhanging Channel	Stone masonry retaining walls - northerly wall is collapsed.
Condition of Discharge Channel	Channel needs to be cleared of fallen rocks and trees to remove backwater. Cut back trees in danger of falling into channel.
	Note: Concrete and steel "Fish Trap" 120' d/s no longer used. Foot bridge is vandalized.

MASSACHUSETTS DEPARTMENT

OF PUBLIC WORKS

INSPECTION REPORTS

APPENDIX B-2B

L-108

INSPECTION REPORT - DAMS AND RESERVOIRS

1. Location: ~~City~~/Town OTIS. Dam No. 1-2-225-8.

Name of Dam Otis Reservoir. Inspected by: RDJordan-FPeplowski

Date of Inspection 5/13/76.

2. Prev. Inspection X.

Owner/s: per: Assessors_____.

Reg. of Deeds_____. Pers. Contact_____.

1. Depaetment of Natural Resources — Boston, MA
   Name | St. & No. | City/Town | State | Tel. No.

2. _____
   Name | St. & No. | City/Town | State | Tel. No.

3. _____
   Name | St. & No. | City/Town | State | Tel. No.

3. Caretaker [if any] e.g. superintendent, plant manager, appointed by absentee owner, appointed by multi owners.

Gilbert Bliss — Cascade St — Pittsfield, MA
Name | St. & No. | City/Town | State | Tel. No.

4. No. of Pictures taken 2.

5. Degree of Hazard: [if dam should fail completely]*

1. Minor_____. 2. Moderate X.

3. Severe_____. 4. Disastrous_____.

*This rating may change as land use changes [future development]

6. Outlet Control: Automatic_____. Manual X.

Operative X yes:_____no.

Comments:_____

Upstream Face of Dam: Condition:

1. Good X. 2. Minor Repairs_____.

3. Major Repairs_____. 4. Urgent Repairs_____.

Comments:_____

8. Downstream Face of Dam: Condition: 1. Good X. 2. Minor Repairs___.
3. Major Repairs___ 4. Urgent Repairs___.

Comments:_____

_____

9. Emergency Spillway: Condition: 1. Good X. 2. Minor Repairs_____.
3. Major Repairs_____.4. Urgent Repairs_____.

Comments:_____

_____

_____

10. Water level @ time of inspection: 3 ft. above____. below X.
top of dam_____.
principal spillway_____.
other emergency spillway

11. Summary of Deficiencies Noted:

Growth [Trees and Brush] on Embankment_____.

Animal Burrows and Washouts_____.

Damage to slopes or top of dam_____.

Cracked or Damaged Masonry_____.

Evidence of Seepage_____.

Evidence of Piping_____.

Erosion_____.

Leaks X_____.

Trash and/or debris impeding flow_____

Clogged or blocked spillway_____.

Other_____

12. Remarks & Recommendations: [Fully Explain] PREVIOUS INSPECTION DATE: July 15, 1974

In general, the dam appears to be in good condition. The brush at the toe has been removed and the area is accessible for inspection. Of the five leaks reported in 1974, only one was noted. It is located approximately 60' northerly of the drawdown gate, at the toe of the stone masoney wall.

The upstream face of the dam and the emergency spillway are in good condition.

For location see topo sheet 6-B.

---

13. Overall Condition:

1. Safe X.
2. Minor repairs needed_____
3. Conditionally safe - major repairs needed_____.
4. Unsafe_____.
5. Reservoir impoundment no longer exists [explain]

   Recommend removal from inspection list_____.

L-168

INSPECTION REPORT - DAMS AND RESERVOIRS

1. Location: ~~XXXX~~ City/Town OTIS. Dam No. 1-2-225-8.

Name of Dam Otis Reservoir. Inspected by: PFreasie

Date of Inspection 7/15/74.

2. Prev. Inspection X.

Owner/s: per: Assessors_____.

Reg. of Deeds_____. Pers. Contact_____

1. Department of Natural Resources 15 Ashburton St [illegible]
Name St. & No. City/Town State Tel.

2. _____
Name St. & No. City/Town State Tel.

3. _____
Name St. & No. City/Town State Tel.

3. Caretaker [if any] e.g. superintendent, plant manager, appointed by [illegible] owner, appointed by multi owners.
Gilbert Bliss Cascade St Pittsfield, MA
Name St. & No. City/Town State Tel.

4. No. of Pictures taken 4.

5. Degree of Hazard: [if dam should fail completely]*

1. Minor_____. 2. Moderate X

3. Severe_____. 4. Disastrous_____

*This rating may change as land use changes [future development]

6. Outlet Control: Automatic_____. Manual: X

Operative X yes; _____ no.

Comments: _____

_____

_____

Upstream face of Dam: Condition:

1. Good X. 2. Minor Repairs_____

3. Major Repairs_____. 4. Urgent Repairs_____

Comments: _____

_____

_____

8. Downstream Face of Dam: Condition: 1. Good____. 2. Minor Repairs____.
3. Major Repairs X 4. Urgent Repairs____.

Comments: See report

9. Emergency Spillway: Condition: 1. Good____. 2. Minor Repairs____.
3. Major Repairs____. 4. Urgent Repairs____.

Comments: None

10. Water level @ time of inspection: .2 ft. above____. below X.
top of dam____.
principal spillway X.
other____.

11. Summary of Deficiencies Noted:

Growth [Trees and Brush] on Embankment X

Animal Burrows and Nesnouts____.

Damage to slopes or top of dam____.

Cracked or Damaged Masonry____.

Evidence of Seepage X

Evidence of Piping____.

Erosion____.

Leaks____.

Trash and/or debris impeding flow____.

Clogged or blocked spillway____.

Other____.

12. Remarks & Recommendations: [Fully Explain]

On inspection of this structure a very severe condition was noted along the stone masonry wall on the downstream side of the dam opposite the gate house. Water was flowing in relatively large amounts from approximately five areas along this wall indicating the possibility of piping through the structure. Because of the size of the reservoir this situation should be attended to immediately and whatever corrections that are necessary should be made.

Also there is brush along the base of the dam that should be cleared away.

A description of this structure was submitted in 1972.

There are no changes to be noted.

For location see Topo 6-B.

13. Overall Condition:

1. Safe_____.
2. Minor repairs needed_____.
3. Conditionally safe - major repairs needed__x__.
4. Unsafe_____.
5. Reservoir impoundment no longer exists [explain]

   Recommend removal from inspection list_____.

L-168

INSPECTION REPORT - DAMS AND RESERVOIRS

1. Location: City/Town OTIS. Dam No. 1-2-235-8.

Name of Dam Otis Reservoir. Inspected by: R D Jordan.

Date of Inspection 11/13/72.

2. Prev. Inspection X.

Owner/s: per: Assessors_____.

Reg. of Deeds_____. Pers. Contact_____.

1. D N R — 15 Ashburton St. — Boston

Name — St. & No. — City/Town — State — Tel. No.

2. _____

Name — St. & No. — City/Town — State — Tel. No.

3. _____

Name — St. & No. — City/Town — State — Tel. No.

3. Caretaker [if any] e.g. superintendent, plant manager, appointed by absentee owner, appointed by multi owners.

Bilbert Bliss — Cascade St. — Pittsfield

Name — St. & No. — City/Town — State — Tel. No.

4. No. of Pictures taken 3.

5. Degree of Hazard: [if dam should fail completely]*

1. Minor_____. 2. Moderate X.

3. Severe_____. 4. Disastrous_____.

*This rating may change as land use changes [future development]

6. Outlet Control: Automatic_____. Manual X.

Operative X yes. _____ no.

Comments:_____

7. Upstream Face of Dam: Condition:

1. Good X. 2. Minor Repairs_____.

3. Major Repairs_____. 4. Urgent Repairs_____.

Comments:_____

8.

Downstream Face of Dam: Condition: 1. Good X. 2. Minor Repairs___.

3. Major Repairs___. 4. Urgent Repairs___.

Comments:_____

_____.

9.

Emergency Spillway: Condition: 1. Good X. 2. Minor Repairs_____.

3. Major Repairs_____. 4. Urgent Repairs_____.

Comments:_____

_____

_____

10.

Water level @ time of inspection: 6 ft. above_____. below X.

top of dam X.

principal spillway_____.

other_____.

11.

Summary of Deficiencies Noted:

Growth [Trees and Brush] on Embankment X.

Animal Burrows and Washouts_____.

Damage to slopes or top of dam_____.

Cracked or Damaged Masonry_____.

Evidence of Seepage_____.

Evidence of Piping_____.

Erosion_____.

Leaks_____.

Trash and/or debris impeding flow_____.

Clogged or blocked spillway_____.

Other_____.

12. Remarks & Recommendations: [Fully Explain]

Dam appears to be in good condition. Some minor seepage was noted at the spillway. The gates were open for the winter drawdown. The brush at the toe of the stone masonry wall should be cut back. Other then minor brush cutting the dam is well maintained.

13. Overall Condition:

1. Safe___ X _____.
2. Minor repairs needed_____.
3. Conditionally safe - major repairs needed_____.
4. Unsafe_____.
5. Reservoir impoundment no longer exists [explain]

Recommend removal from inspection list_____.

L-169

DESCRIPTION OF DAM

DISTRICT ONE.

Submitted by R D JORDAN. Dam No. 1-2-235-8

Date 11-13-12. City/Town OTIS

Name of Dam Otis Reservoir

1. Location: Topo Sheet No. 6-B.

Provide 8-1/2" x 11" in clear copy of topo map with location of Dam clearly indicated.

2. Year built: 1888. Year/s of subsequent repairs 1959

3. Purpose of Dam: Water Supply ____. Recreational X.

Irrigation ____. Other ____.

4. Drainage Area: 17 sq. mi. ____ acres.

5. Normal Ponding Area: 1065 Acres; Avg. Depth ____.

Impoundment: ____ gals; ____ acre ft.

6. No. and type of dwellings located adjacent to pond or reservoir ____

i.e. summer homes etc. ____

7. Dimensions of Dam: Length 625'. Max. Height 31'.

Slopes: Upstream Face riprapped earth 2/1.

Downstream Face stone masonry.

Width across top 28'.

8. Classification of Dam by Material:

Earth X. Conc. Masonry ____. Stone Masonry X.

Timber ____. Rockfill ____. Other ____.

9. A. Description of present land usage downstream of dam: ____

100 %rural; ____ % urban.

B. Is there a storage area or flood plain downstream of dam which could accommodate the impoundment in the event of a complete dam failure

Yes ____. No X.

B2-17

L-169 A

DAM NO. 1-2-285-8.

10.

Risk to life and property in event of complete failure.

Loss of life could be moderate, property damage could be quite severe. Water would eventually pond in cold Springs Reservoir & Conn. line.

No. of people_____.

No. of Homes_____.

No. of Businesses_____.

No. of Industries_____. Type_____.

No. of Utilities_____. Type_____.

Railroads_____.

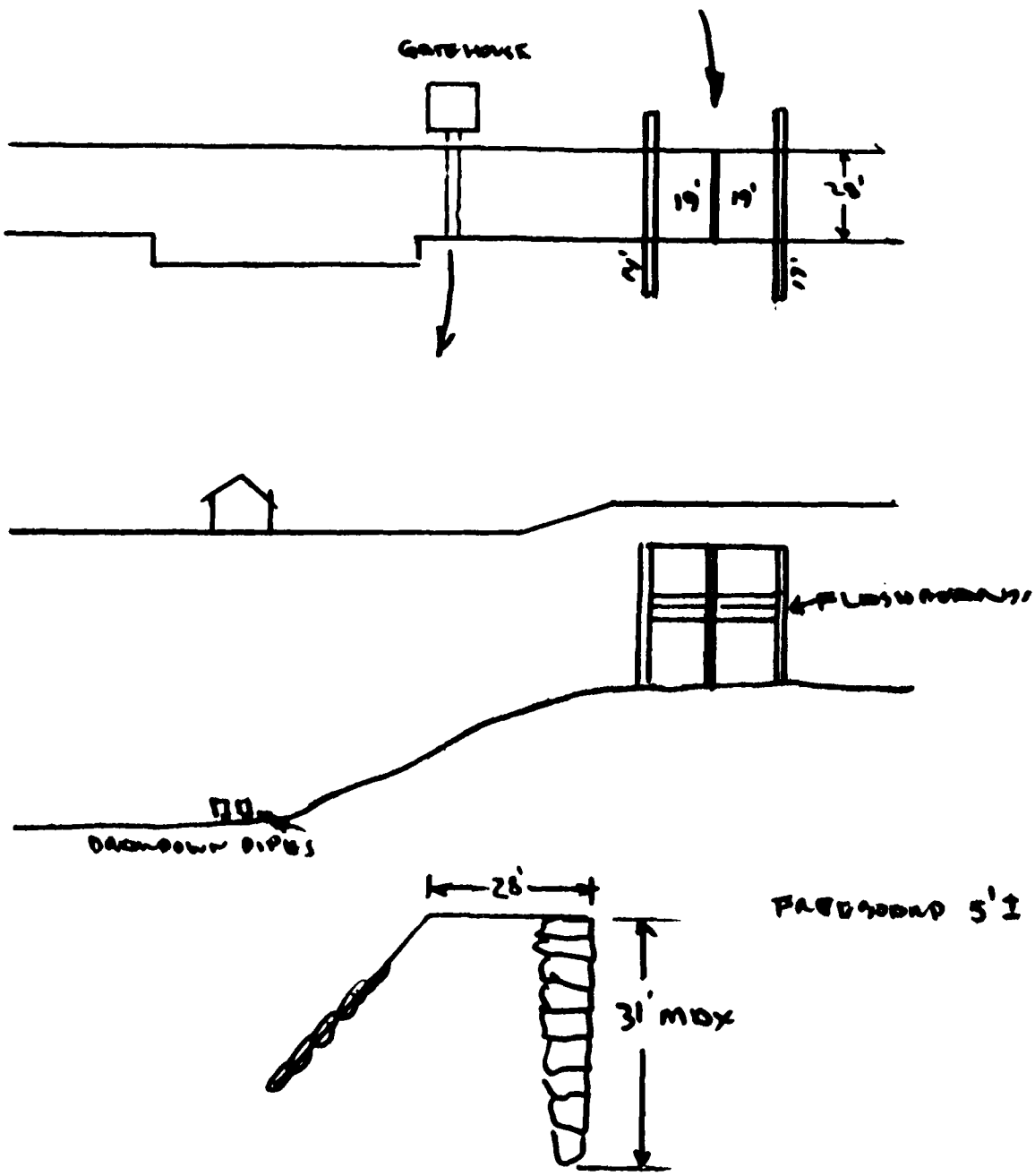
Other dams Cold Springs Reservoir

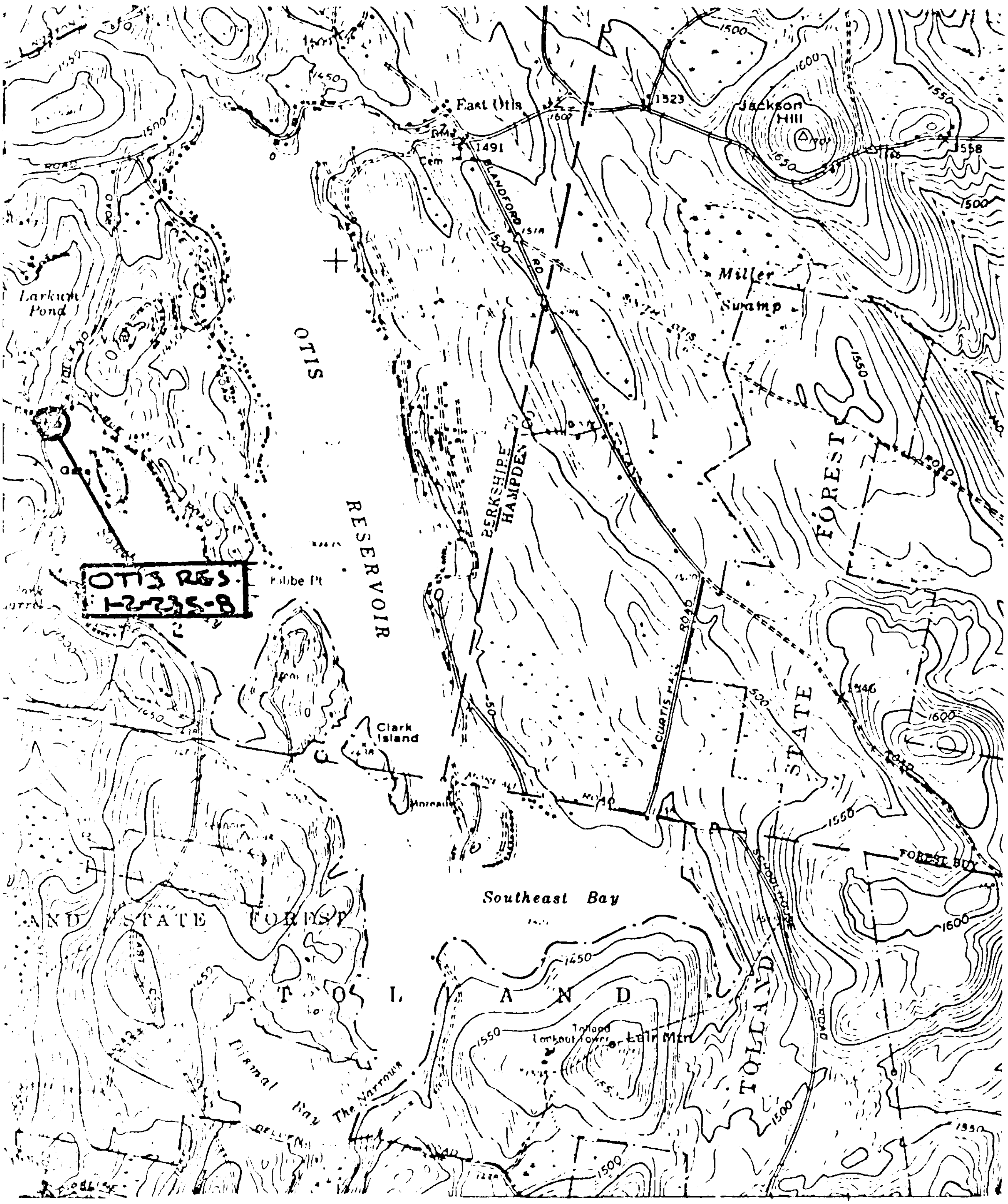
Other Route 8.

11.

Attach Sketch of dam to this form showing section and plan on 8-1/2" x 11" sheet.

OTIS RGS 1-2-25-8




East Otis
1523
Jackson Hill
1491
1558
BLANDFORD RD
Larkum Pond
Miller Swamp
OTIS
RESERVOIR
BERKSHIRE
HAMPDEN
FOREST
OTIS RES
1-2-735-8
Clark Island
CURTIS
ROAD
STATE
1546
Southeast Bay
AND STATE FOREST
T O L L A N D
TOLLAND
Tolland Lookout Tower
Dismal Bay
The Narrows
SCHOOLHOUSE
1450
1500
1550
1600
1650

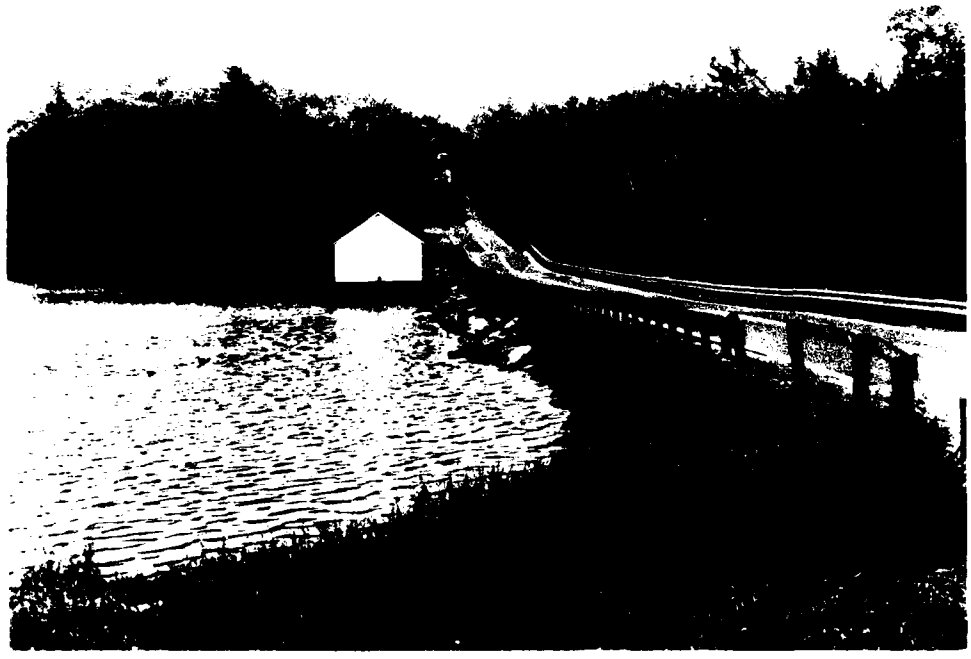


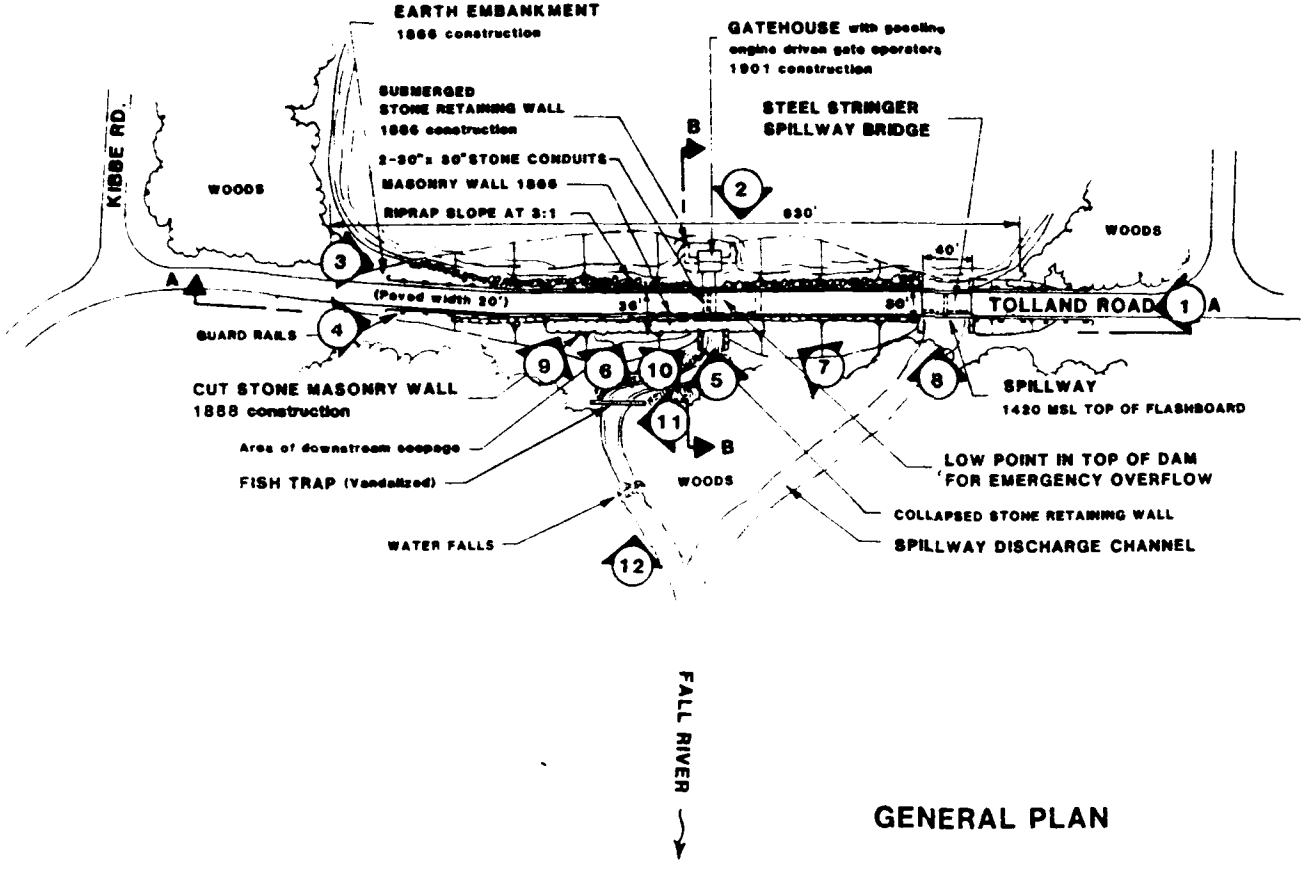
Figure 3 - View of top of dam looking southwesterly. Note wooden gate house with gage board attached to concrete pier at center of gate house. Gate house is balanced over center pier. Abutment piers for access bridge provide stability for the structure. Tipping of piers towards the reservoir indicates movement. Note riprap at upstream face of dam.

Figure 4 - View of downstream face of dam looking southwesterly. Note low point in top of dam (Tolland Road). Low point is intended to act as an emergency spillway. Note stone masonry wall at downstream face of dam.

Figure 1 - View of top of dam looking northeasterly along Tolland Road. Principal spillway is beneath the bridge in the foreground. Gate house is the wooden building to the right of top of dam. Note puddled surface water in pavement depression.

Figure 2 - Photograph of a photograph taken when reservoir was drawn down in 1956. Photograph is on file at the Berkshire County Commissioner's office. Note concrete pier supporting gate house. Also note gate stems attached to concrete pier. A wooden trash rack is in front of the gates.

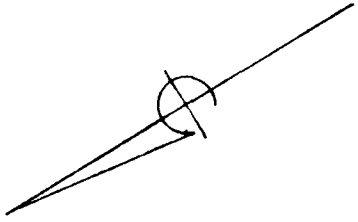
OTIS RESERVOIR



GENERAL PLAN

Note: Elevation datum taken from plan dated 1956 prepared by W.A.Heaphy entitled Plan and Profile of Otis Reservoir Dam Stone masonry crest of spillway elevation 1418.9 MSL

1 INDICATES PHOTOGRAPH NUMBER AND DIRECTION IN WHICH PHOTOGRAPH WAS TAKEN



NOTE:

PHOTO	LOCATION
13 –	OUTLET STRUCTURE, BIG POND, OTIS
14 –	RESERVOIR ROAD BRIDGE, FARMINGTON RIVER
15 –	ROUTE 8 BRIDGE, NEW BOSTON

PHOTOGRAPH INDEX

APPENDIX C-1

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS

ROBERT G. BROWN & ASSOCIATES, INC
Pittsfield, Massachusetts

NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS

OTIS RESERVOIR DAM

MA 00308

FALL RIVER

OTIS MASSACHUSETTS

SCALE: NOT TO SCALE | DATE AUGUST 1980

APPENDIX C

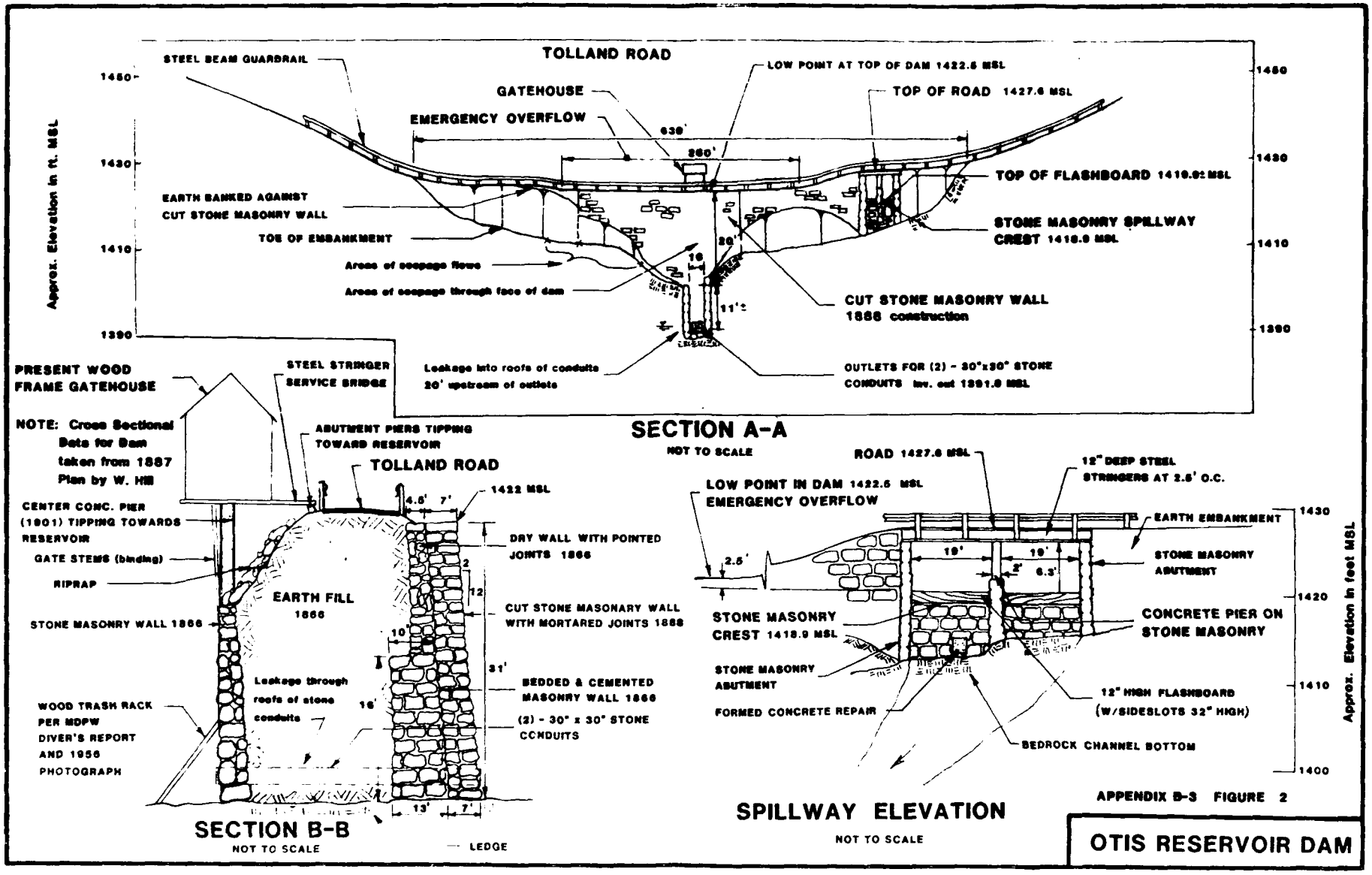
PHOTOGRAPHS

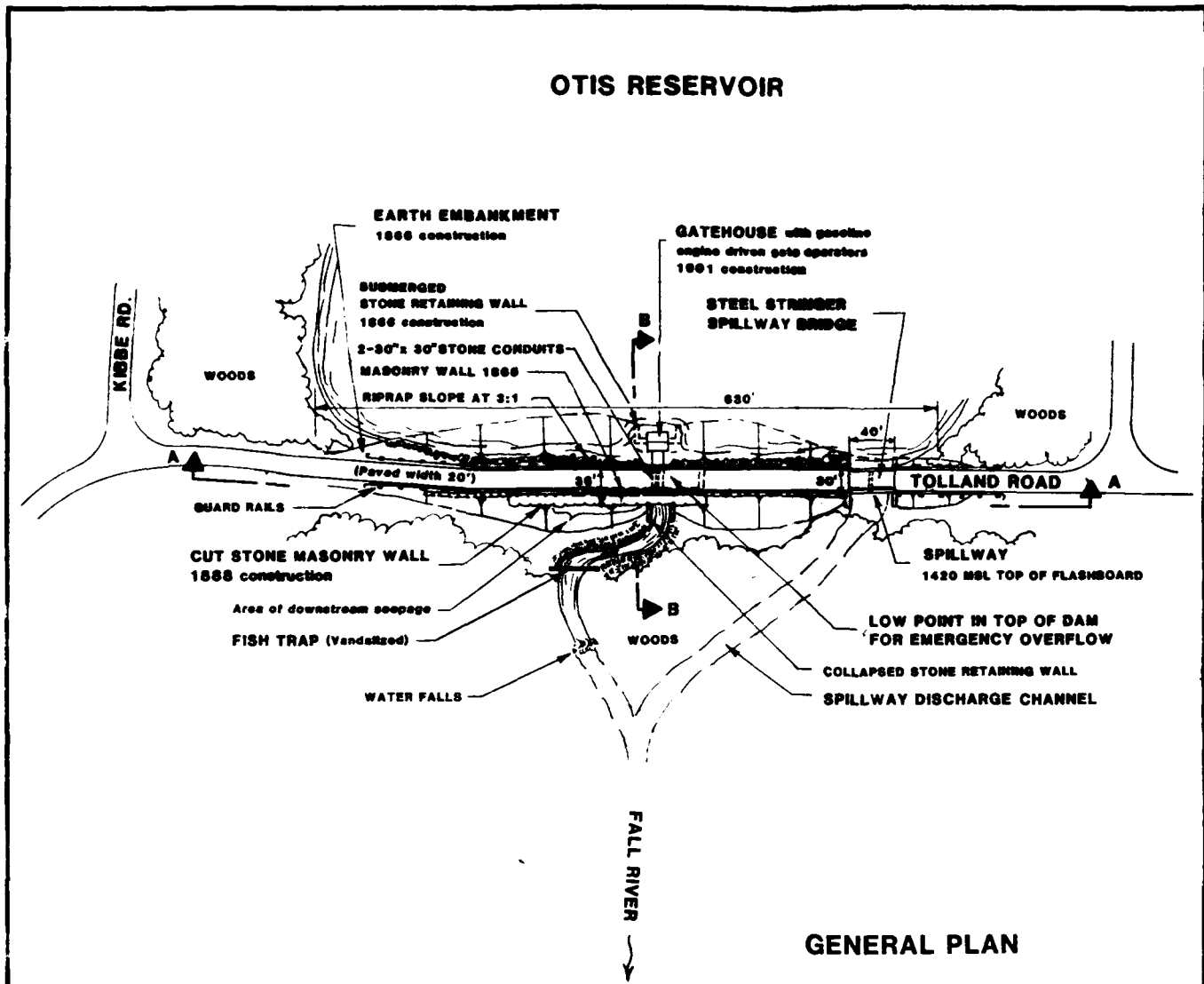
C-1. PHOTOGRAPH INDEX

C-2. SELECTED PHOTOGRAPHS

TYPICAL BORING LOGS

A. None available


TOLLAND ROAD
STEEL BEAM GUARDRAIL
GATEHOUSE
EMERGENCY OVERFLOW
LOW POINT AT TOP OF DAM 1422.6 MSL
TOP OF ROAD 1427.6 MSL
630'
360'
TOP OF FLASHBOARD 1419.0± MSL
STONE MASONRY SPILLWAY CREST 1418.0 MSL
EARTH BANKED AGAINST CUT STONE MASONRY WALL
TOE OF EMBANKMENT
Areas of seepage flows
Areas of seepage through face of dam
20'
16'
11'±
CUT STONE MASONRY WALL 1866 construction
Approx. Elevation in ft. MSL
1450
1430
1410
1390
Leakage into roofs of conduits 20' upstream of outlets
OUTLETS FOR (2) - 30"x30" STONE CONDUITS Inv. out 1391.0 MSL
SECTION A-A
NOT TO SCALE
PRESENT WOOD FRAME GATEHOUSE
STEEL STRINGER SERVICE BRIDGE
ABUTMENT PIERS TIPPING TOWARD RESERVOIR
NOTE: Cross Sectional Data for Dam taken from 1887 Plan by W. Hill
TOLLAND ROAD
1422 MSL
4.5'
7'
CENTER CONC. PIER (1901) TIPPING TOWARDS RESERVOIR
GATE STEMS (binding)
RIPRAP
EARTH FILL 1866
STONE MASONRY WALL 1866
DRY WALL WITH POINTED JOINTS 1866
2
12
CUT STONE MASONARY WALL WITH MORTARED JOINTS 1866
10'
31'
BEDDED & CEMENTED MASONRY WALL 1866
Leakage through roofs of stone conduits
16'
(2) - 30" x 30" STONE CONDUITS
WOOD TRASH RACK PER MDPW DIVER'S REPORT AND 1956 PHOTOGRAPH
13'
7'
LEDGE
SECTION B-B
NOT TO SCALE
ROAD 1427.6 MSL
12" DEEP STEEL STRINGERS AT 2.5' O.C.
LOW POINT IN DAM 1422.6 MSL
EMERGENCY OVERFLOW
EARTH EMBANKMENT
2.5'
19'
19'
2'
6.3'
STONE MASONRY ABUTMENT
STONE MASONRY CREST 1418.9 MSL
CONCRETE PIER ON STONE MASONRY
STONE MASONRY ABUTMENT
12" HIGH FLASHBOARD (W/SIDESLOTS 32" HIGH)
FORMED CONCRETE REPAIR
BEDROCK CHANNEL BOTTOM
1430
1420
1410
1400
Approx. Elevation in feet MSL
SPILLWAY ELEVATION
NOT TO SCALE
APPENDIX B-3 FIGURE 2
OTIS RESERVOIR DAM



GENERAL PLAN

Note: Elevation datum taken from plan dated 1956 prepared by W.A.Heaphy entitled Plan and Profile of Otis Reservoir Dam Stone masonry crest of spillway elevation 1418.9 MSL

APPENDIX B-3 FIGURE 1

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS

ROBERT G. BROWN & ASSOCIATES, INC
Pittsfield, Massachusetts

NATIONAL PROGRAM FOR
INSPECTION OF NON-FEDERAL DAMS

OTIS RESERVOIR DAM

MA 00308

FALL RIVER

OTIS MASSACHUSETTS

SCALE: NOT TO SCALE | DATE: AUGUST 1980

A. SKETCHES COMPILED DURING PHASE I INSPECTION SHOWING GENERAL LAYOUT OF DAM, TYPICAL SECTIONS AND DETAILS OF SIGNIFICANT FEATURES:

Figure 1. General Plan of Damsite

Figure 2. Typical Sections

B. RECORD PLANS:

Original plans not found. 1888 modification plans are not attached but data from plans has been included on Figures 1 and 2 attached.

to the elevation of the top of the masonry wall in the section provided for in the act of 1888.

I would recommend that a meeting be held with the representatives of the owners of the dam, the Farmington River Water Power Co., the aforementioned reference to discuss or arrange to have the additional spillway capacity provided for, also to discuss flashboards, their height and design, etc.

Respectfully submitted,

Harry W. Heapty,
County Engineer.

HWH/cr

THE COMMONWEALTH OF MASSACHUSETTS

County of Berkshire

PITTSFIELD, MASSACHUSETTS

June 18, 1956

Berkshire County Commissioners,
Court House,
Pittsfield, Massachusetts.

Gentlemen:-

An inspection was made of the dam at East Otis Reservoir today in company with Clifford A. Clark, Chairman of the Selectmen of the Town of Otis. At the time of our visit the reservoir was entirely dry with the exception of the brook or channel in the bottom of the reservoir and those portions of the reservoir which were parts of the old natural ponds. The upstream or water side of the dam has a slope covered with loose rock its entire length except at gates where the masonry walls appear to be in good condition. No evidence is visible on this slope of any damage whatsoever due to flood conditions of August 18th and 19th, 1955. The gates have been opened for several weeks past in order to draw off the water so that repairs could be made to the two 30" x 30" masonry sluices or culverts that lead the water from the gates under the dam to the brook below. Workmen from the Farmington River Water Power Co. brought some material and equipment to the site today preparing for anchoring one of the stones in the dividing wall between the sluices which has become dislodged and has been partially blocking the discharge of water from the gates. Non rusting metal straps are to be used to hold and anchor the dislodged stone or stones in its original position in the wall. When this repair is completed the gates are to be closed and the reservoir allowed to fill.

Before the water reaches spillway level repairs are required at the northwest corner of the spillway where some erosion and undermining has taken place at the base of the stone abutment. All soft material and decomposed rock should be removed down to solid ledge and replaced with approved concrete footing. The northerly half of the spillway overflow wall needs repairs, pointing, etc., on the downstream face.

A survey has been made of the dam and road showing plan, profile and cross sections. It appears that over the years the travelled portion of the road across the dam has been raised so that at present it is higher than originally designed for. At the public meeting held at the dam on September 20, 1955, after the flood of August 18th-19th, it was brought out by the Army Engineers that the spillway capacity for this pond should be increased to care for a flood condition such as we had in August 1955. This can be provided by either a new spillway in addition to the present one, or by cutting down the roadway on the dam

by the height of flashboards. Flashboard pins should be properly designed to fail at the predetermined water elevation and if necessary should be notched to guarantee failure.

At the time of my visit to the Reservoir on Oct. 21, 1958, the gates on the two sluiceways were closed and approximately 7.5 ft. of water was in the Reservoir above the bottom of the gates. The gates were thus not visible for inspection. It is my understanding that these gates were recently repaired and apparently, in the opinion of the Owner, are in satisfactory operating condition. Leakage thru the gates was noted and records of this leakage have been made and are being kept by you. Since the measuring weirs were installed in the sluiceways it has been noted that the leakage thru the easterly gate has increased slightly, while that in the westerly gate has decreased. In spite of this leakage there has been a small increase in the depth of water upstream of the gates.

I was able to observe the leakage by looking up thru the two sluiceways from their discharge ends. I noted that the gates appeared to be leaking on their sides and near the upper portion of the edges of the gates. It would thus appear that the gates are not seating tightly along the sides near their upper half nor along the top. It is possible that as the pressure against these gates increases due to filling of the Reservoir, the gates may seat more tightly and leakage may diminish. It is also possible that the leakage would increase. Since I was not able to examine the gates because of the fact that they were flooded, I can give no further opinion on this matter.

In regard to damage downstream because of gate failure, I do not believe that such failure presents a problem. The quantity of water that would be discharged would not be great enough to cause flood damage and the likelihood of both gates failing at the same time is extremely small.

The problem of leakage seems more important in regard to maintaining the pond rather than in regard to safety of the dam itself. If there is any question regarding the condition of these gates, then I would recommend that this matter be taken up with the Owners of the dam immediately in order that any information needed to determine their condition and any work required could be obtained or done while the water level in the Reservoir is low. I have not gone to the Engineers of the Owners, but if you so desire, I would be pleased to discuss the matter of these gates, the recent repairs to them, their tightness and future operations programs that would involve their use.

Respectfully submitted

Tippetts-Abbett-McCarthy-Stratton

George W. McConnell
Chief Engineer

GWM/cmk

masonry wall was apparently built in two sections and as a result is quite massive. Old plans indicate that for a height of 31' 7" the base of the masonry construction is 20 ft. wide. If detailed investigations that have already been initiated indicate that this downstream masonry wall is founded on ledge and is as massive as shown, it would seem possible and practical to grade and pave the top of the dam in the central portion to allow for the overflow of excessive storm water discharge.

The paving should be constructed to cap the masonry wall to form a leak resistant joint at the upstream edge of the pavement and should be tied well into the earth of the dam and the riprap of the upstream slope to prevent flow of water under the paving. By making use of the top of the dam for a distance of about 300 ft. as an emergency overflow crest, it must be remembered that in time of extreme storm flow, Tolland Road would be temporarily out of service and access to the spillway from the northerly end of the dam might require approach from the south. Ordinarily, however with flow of water over the regraded Tolland Road, equipment and personnel could probably safely cross the emergency spillway area in the relatively shallow overflowing water.

Immediately downstream of the stone wall there is an earth embankment of variable depth that covers the natural ledge. In time of overflow in the emergency spillway this earth could be washed away. Based upon information obtained during our preliminary study of this dam, it is highly probable that the stone masonry wall does not need this earth for stability. However, the earth protects the natural ledge and does provide a resisting pressure to any tendency for the wall to move outward. In my opinion it would be worthwhile to preserve this earth from washout in time of emergency overflow by paving the area immediately downstream of this wall with exceptionally heavy boulders and riprap. The paving should probably be 2 ft. or more in thickness and would not of necessity be entirely hand placed.

At the time of my inspection of Otis Reservoir, no flashboards were on the spillway. Ordinarily 32" of flashboards have been maintained on this spillway.

It is my understanding that the shoreline of Otis Reservoir is used for recreational purposes by many permanent citizens of Otis as well as summertime residents. I assume that these persons are all interested in maintaining a given water level in order to make use of their recreational facilities. Since 32" of flashboards have been maintained at this dam in the past, the shoreline and related facilities have probably been developed in accordance with this water level elevation.

When flashboards are replaced on the spillway they should be kept as low as possible taking into consideration the shoreline problems involved. They should also be installed in such a manner that they will easily fail and be washed away when they are topped by a predetermined depth of discharge. This depth should probably be 6" to 1 ft. maximum over the flashboards. The overflow level being governed

WATER SUPPLY
SEWERAGE
SEWAGE DISPOSAL
STRUCTURAL ENGINEERING
ELECTRICAL ENGINEERING

TIGHE & BOND, INC.
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BOWERS AND PEQUOT STREETS
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DAMS & POWER INSTALLATIONS
HIGHWAYS & BRIDGES
HOUSING DEVELOPMENT
WASTE DISPOSAL

Pittsfield
BERKSHIRE

3/o Berk.County
Nov. , 1936.

The non. the Board of County Commissioners
County of Berkshire
Pittsfield, Massachusetts

Att: Harry W. Heaphy, County Engr.

Gentlemen:

In accordance with your request, I have made a field inspection of the dam at Otis Reservoir, in Otis, Massachusetts. I will not go into detail describing this dam since such information is well known to you and is available in your files. The dam is a relatively massive structure composed of a masonry wall on the downstream side, earth fill and a rip-rap paved embankment on the pond slope. The dam embankment carries Tolland Road.

The spillway is a masonry overflow structure at the left end of the dam and is composed of two sections divided by a masonry pier.

It is my understanding, flashboards 32" in height were ordinarily maintained on the crest of the overflow spillway. The spillway, even with the flashboards removed has a relatively small capacity based upon the drainage area of Otis Reservoir.

The Gate house situated near the central portion of the dam and upstream from Tolland Road, contains 2 - 30"x30" sluiceways having cast gates at the upstream end of these sluices. The gates apparently are manually operated and were installed for the purpose of draining water from the Reservoir to feed the stream below. Records indicate that the capacity of the existing spillway is about 850 cu. ft. per second with 1 ft. of water passing over the crest. The capacity of both sluiceways with the gates wide open and the Reservoir full is about 320 cu.ft. per second. Thus, the total ability of the structure to pass water with a pond level 1 ft. higher than spillway crest would be somewhere in the neighborhood of 1200 cu.ft. per second. This is a small capacity based upon the drainage area involved.

In order to safely pass flood flows of a magnitude of that of August 1955, the spillway capacity of the dam should be increased. This capacity could be increased in a number of ways but the most practical and economical would apparently be the taking advantage of the ability of the dam to pass water over a portion of the central section of the structure by lowering the road grade and paving the entire top of the dam in this lowered section.

On the downstream face of the main portion of the dam, the stone

BERKSHIRE COUNTY ENGINEERS

INSPECTION REPORTS

APPENDIX B-2C

Figure 5 - Outlets for the two 30-inch by 30-inch stone conduits. Gates at the inlets of the conduits are controlled by gate operators in the gate house. Leaks in the roofs of these conduits were noted 20 feet upstream of the outlets.

Figure 6 - View of the cut stone masonry wall at the downstream face of dam. Note grass and small brush growing out of the joints. Wall alignment, both horizontal and vertical, is good. Seepage was noted at the base of the stone masonry wall in the area of this photograph. (See Photograph 9)

Figure 7 - View of cut stone masonry wall at downstream face of dam. Note small brush and grass growing out of joints and along top of dam. Earth in foreground is banked up against stone masonry wall.

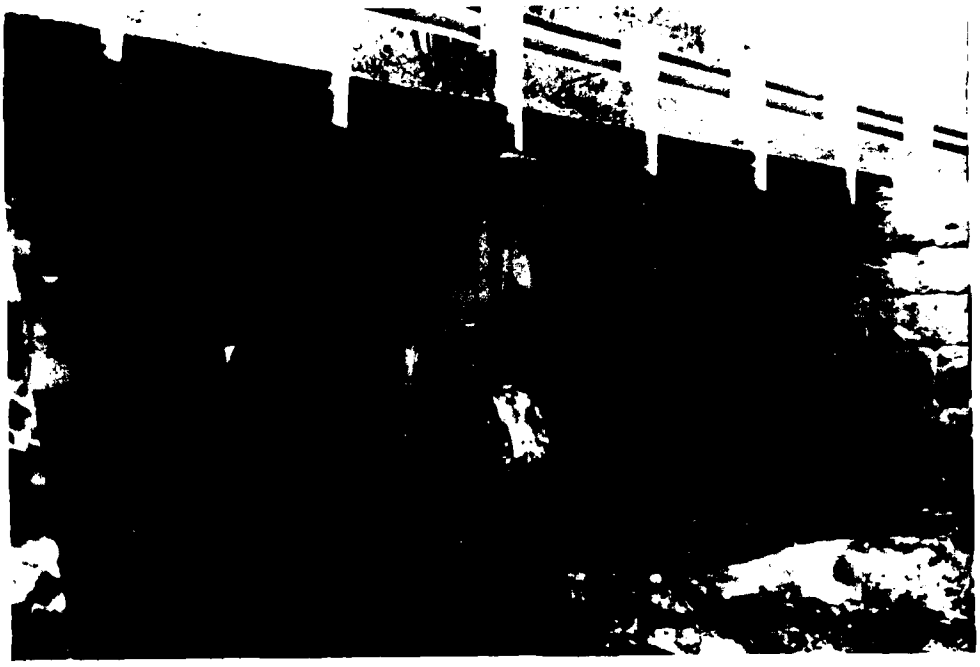

Figure 8 - View of the downstream face of the principal spillway weir. Note center pier which supports bridge. Note wooden flashboard with pins; also note 32-inch high flashboard slots. Steel stringer bridge above spillway carries Tolland Road.

Figure 9 - Area of downstream seepage. Note seepage flow originating at joints in the cut stone masonry.

Figure 10

View of partially collapsed stone masonry retaining wall on north side of discharge channel for the two 30-inch by 30-inch stone conduits.

Figure 11 - View of fish trap located about 120 feet downstream of outlets to the two stone conduits. Note steel screens and foot bridge have been vandalized.

Figure 12 - View of the channel just downstream of the fish trap shown in the above photograph. Flow in this area is primarily the result of leakage from the two 30-inch by 30-inch conduits.

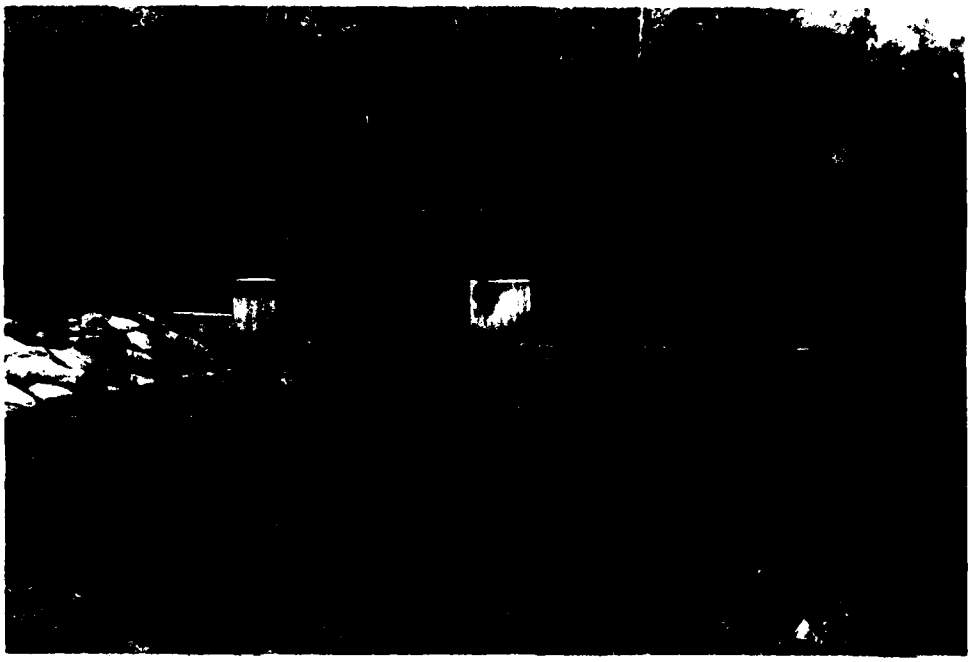

Figure 13 - View (looking upstream) of the outlet structure for Big Pond. Note that this structure is not a dam but is only a level control structure. One half of the Otis Reservoir watershed drains through Big Pond.

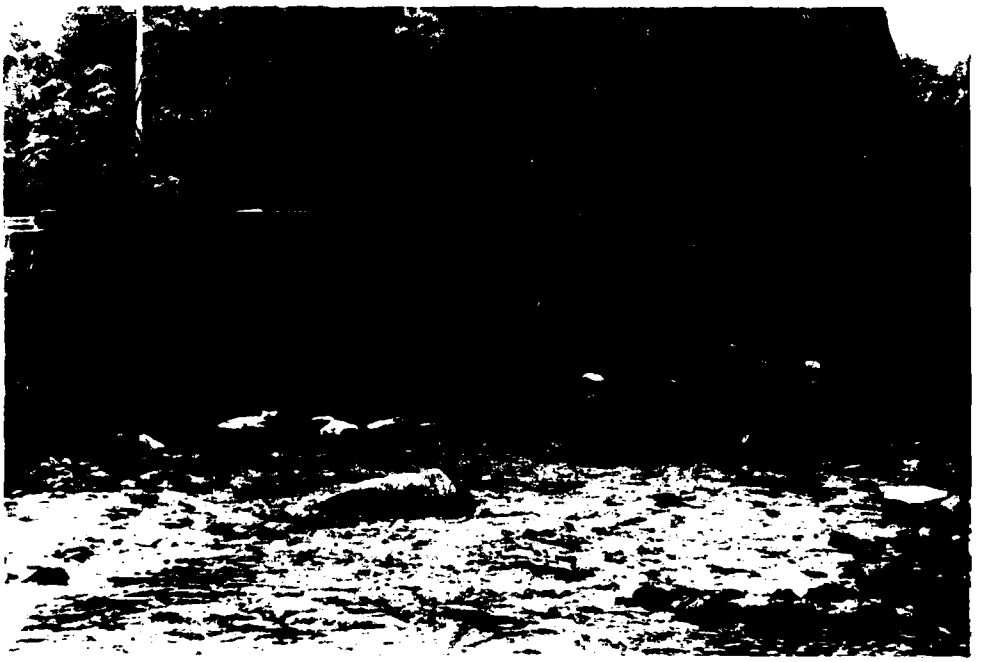

Figure 14 - View (looking upstream) of steel stringer bridge on the west branch of the Farmington River just downstream of where the Fall River enters the west branch of the Farmington River.

Figure 15 - View (looking downstream) of the steel truss bridge on Route 8 in the Village of New Boston near the Junction of Route 57. Note building to the left of bridge which has apartments, store and post office. Structures in this area would be severely damaged or destroyed and a loss of more than a few lives could be expected as a result of a major dam break at Otis Reservoir.

APPENDIX D

HYDRAULIC AND HYDROLOGIC COMPUTATIONS

D-1. DRAINAGE AREA MAP

D-2. COMPUTATIONS

Robert G. Brown & Associates, Inc.

MA 308 Otis Reservoir

SHEET NO. 1 OF 18

CALCULATED BY JFC DATE 6/10/80

CHECKED BY JMC DATE 7/20/80

Step 1 Calculate PMF using "Preliminary Guidance for Estimating Maximum Probable Discharges in Phase I Dam Safety Inspections" March 1978

Drainage Area = 15.9 sq Mi by planimeter

Note - Northern 1/2 of drainage area North of Rt 23 is largely swamp, draining thru Big Pond, Southern 1/2 also has swamp and large percentage of water surface area. Because of retarding effect of swamps CSM rate for flood peaks are reduced. Large percentage of open water will tend to increase CSM rate. Therefore use CSM value midway between curve for Flat Terrain and Rolling Terrain will be used.

CSM_{PMF} = 650 + 0.5 (1500-600) = 1100 CSM

PMF = 1100 CSM x 16 SM = 17,600 cfs

1/2 PMF = 8800 cfs

Hazard Class → High

Size → Intermediate

→ PMF

Note: Use 1/2 PMF

APPENDIX

FORM 204 Available from

Robert G. Brown & Associates, Inc.
Berkshire Common - Third Floor North
PITTSFIELD, MASSACHUSETTS 01201
(413) 499-1560

JOB MA 308 Otis Reservoir
SHEET NO 2 OF 18
CALCULATED BY JFC DATE 6/10/80
CHECKED BY JMC DATE 7/20/80
SCALE

Step 2a Determine Surcharge Ht to pass test flood ½ PMF = 8800 cfs ✓

Compute Stage V Discharge Curve
and Stage V Storage curve

Note. Previous Flood of Record 1955
USGS Gage 1185500 West Br. Farmington R.
Near New Boston - Aug 19, 1955 - 34,300 cfs
from 92.0 Sq mi drainage area.

Assume drawdown gates are open and discharging during flood

$Q_{gates} = CA\sqrt{2gh}$ use $C = 0.6$

Guardrails on roadway over dam would reduce capacity of over the road flow ("emergency spillway action")
Rails about 6.5' o.c. would reduce effective length of overflow crest

Effective length of crest = $450' - 0.4'\left(\frac{450}{6.5}\right) = \underline{422 \text{ ft.}}$ ✓
reduction 7% ✓

Al[illegible] flashboard on spillway remains
[illegible] 423 ±

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JOB MA 308 Otis Reservoir
SHEET NO 3 OF 18
CALCULATED BY JFC DATE 6/10/80
CHECKED BY JMC DATE 7/20/80
SCALE

Elev. MSL	Flow Over Spillway (w/ Flashboard) C	L (ft)	H (ft)	Q (cfs)	Flow over Dam C	L (ft)	H (ft)	Q (cfs)	Flow Thru Gates C	h (ft)	A (ft²)	Q (cfs)	Q TOTAL (cfs)	
1419	–	– –												Masonry Spillway Crest
1420	3.0	38	0	0					0.6	27.3	12.5	314	314	Top of 1st flashbd
1422.5	"	"	2.[illegible]	450					"	29.8	"	329	779	Top of Dam
1425	"	"	[illegible] (1)	1675	2.6	260	2.5	2672	"	32.3	"	342	4689	
1428		"	[illegible]	2378	"	350	5.5	11738	"	35.3	"	358	15174	
1429		"	[illegible]	~~2665~~		"	6.5	15080	"	36.3	"	361	18195	

for [illegible] when water [illegible]
above [illegible] [illegible]
[illegible] 6.7 × $\sqrt{2g\Delta h}$
[illegible] 3
[illegible] 2650 cfs plus
[illegible] overflow
[illegible] 3.16 × 40 × (1)$^{3/2}$ = 104 cfs
[illegible] = 2650 + 104 = 2754 cfs @ 1429

$Q = CA\sqrt{2gh}$

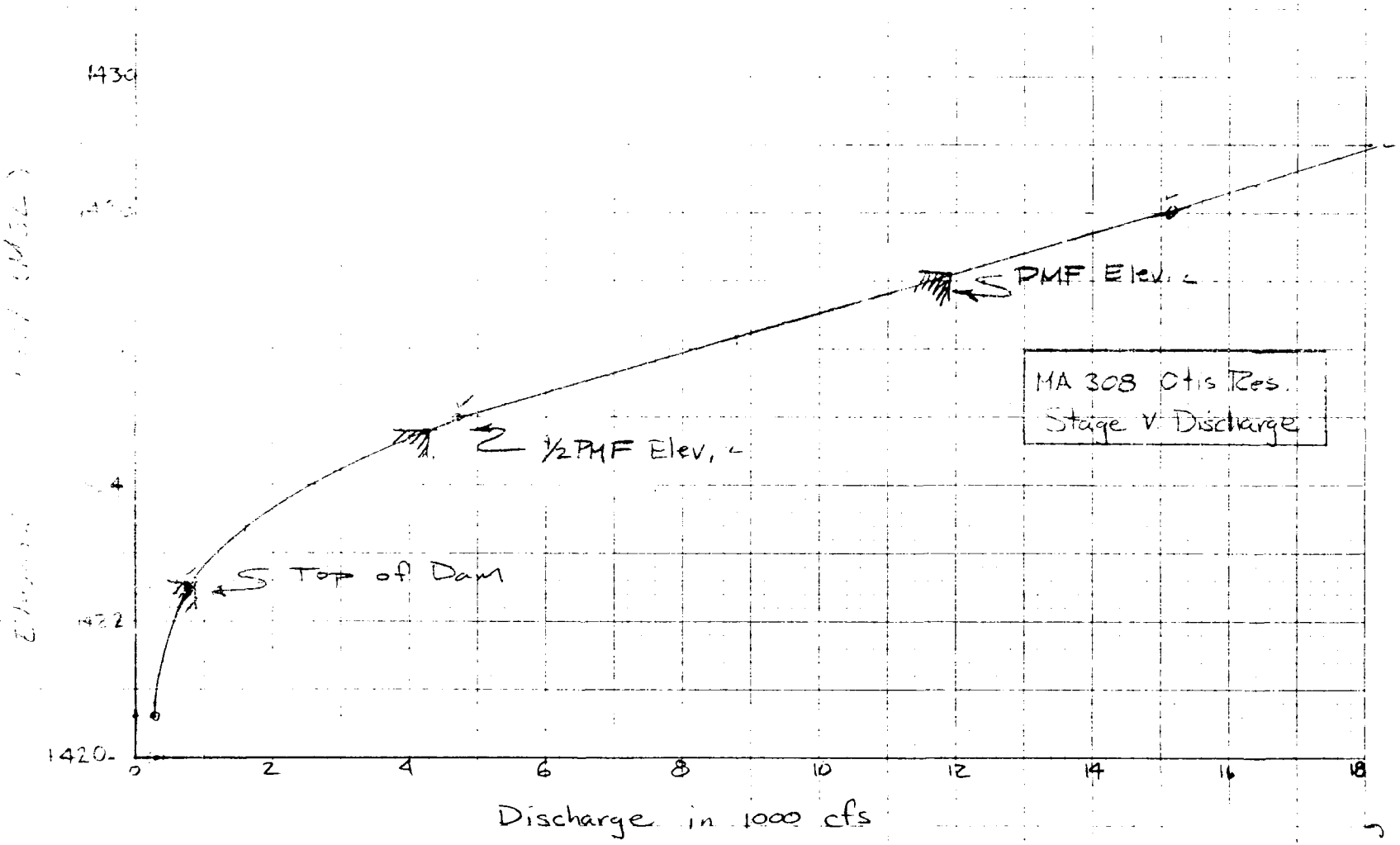
A = 2 gates @ 2.5' × 2.5' = 12.5 sq.ft.

(1) Assume flashboard has yielded

Without flashboard · spillway cap. at 1422.5 =

$Q = (3.0)(38)(3.6)^{1.5} = 780$ cfs

w/o flashbds
780 spillway @ 1422.5
329 gates
1109


1430
1420
PMF Elev.
½PMF Elev.
Top of Dam
MA 308 Otis Res.
Stage V. Discharge
0
2
4
6
8
10
12
14
16
18
Discharge in 1000 cfs

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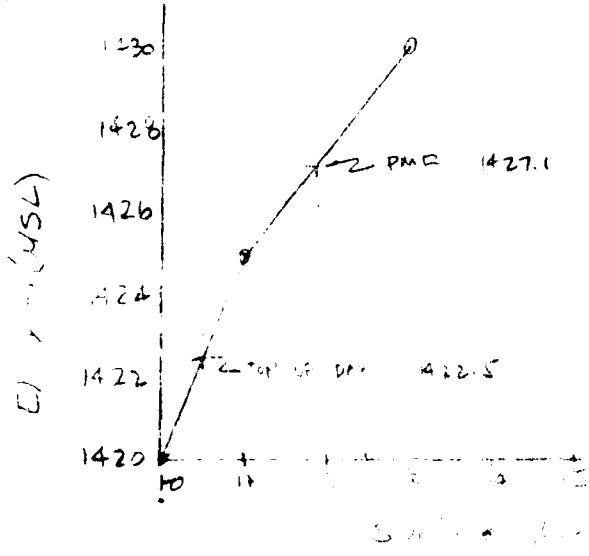
JOB MA308 Otis Reservoir
SHEET NO 5 OF 18
CALCULATED BY JFC DATE 6/10/80
CHECKED BY Jmc DATE 7/20/80
SCALE

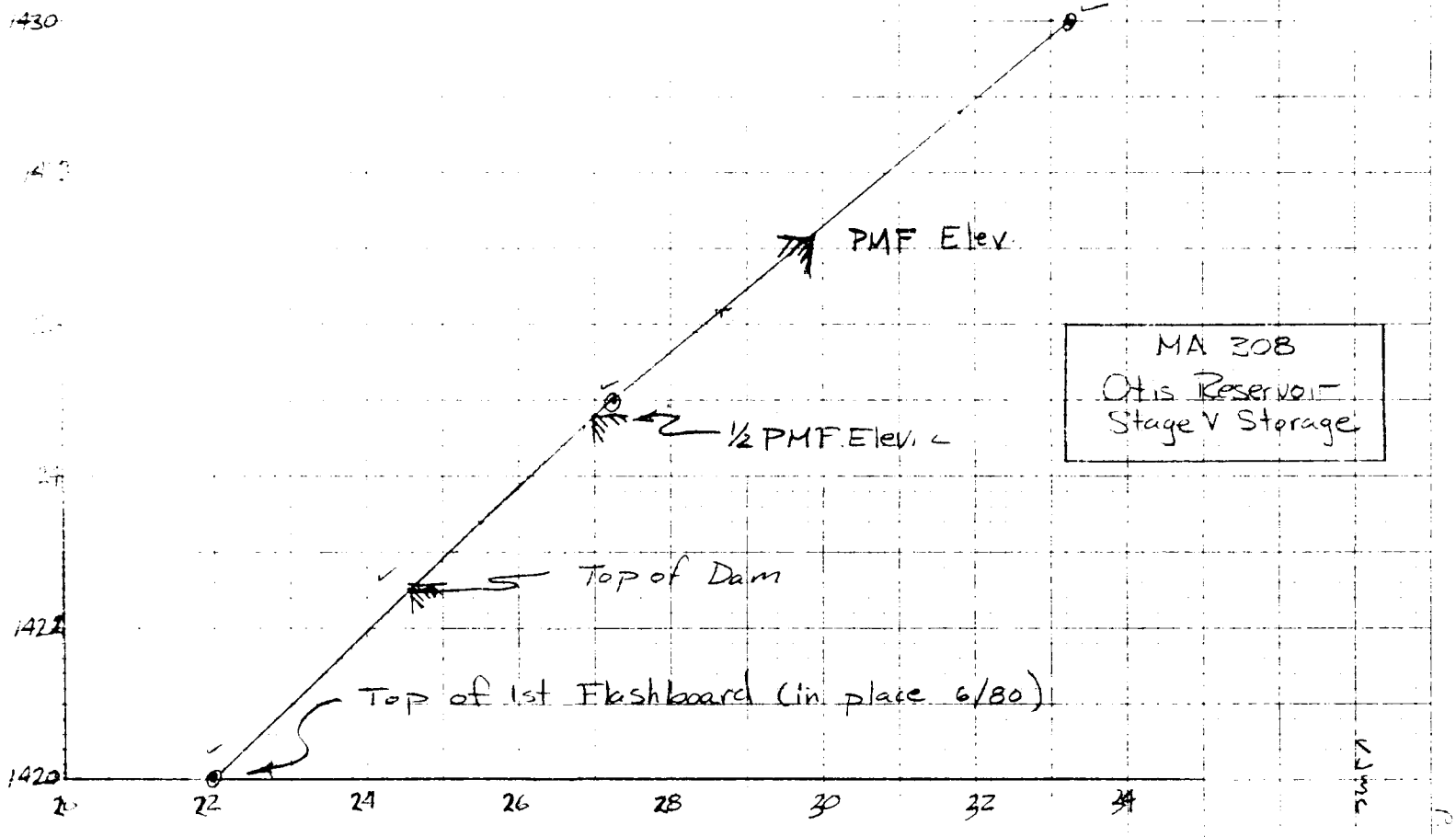
Otis Res. Stage v. Storage Curve

Elev.	Area Ac	Δ Storage Ac-ft	Σ Storage Ac-ft
1420	1000	—	22,000
1425	1100	5250	27,250
1430	1300	6000	33,250

Present pool - Top of 1" ± flashboard

According to Water Resources Research Center Pub No 10-2 An Inventory of Ponds, Lakes and Reservoirs of Massachusetts Berkshire & Franklin County - mean depth of Otis Res is 22 feet - Normal Storage = 22 ft × 1000 Ac = 22000 Ac-ft.
(see Sht 18)




1430
PMF Elev.
½ PMF Elev.
Top of Dam
1421
Top of 1st Flashboard (in place 6/80)
1420
22
24
26
28
30
32
34
Storage in 1000 Ac.-Ft.
MA 308
Otis Reservoir
Stage V Storage

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JOB MA308 Otis Reservoir
SHEET NO 7 OF 13
CALCULATED BY JFC DATE 3/26/80
CHECKED BY JMC DATE 7/20/80
SCALE

Test Flood is PMF - Also check ½ PMF

½ PMF

$Q_{P_1} \rightarrow$ 8800 cfs
$Q_{P_1} \rightarrow$ 1426.2 MSL → 28,600 Ac-ft.
Δ Storage above 1420 MSL = 6,600 Ac-ft

$$STOR_1 = \frac{6,600}{53.3 \times 16.0} = 7.74''$$

$$Q_{P_2} = Q_{P_1} \times \left(1 - \frac{STOR_1}{19/2}\right)$$

$$Q_{P_2} = 8800 \times \left(1 - \frac{7.74}{9.5}\right) = 1630 \text{ cfs}$$

$Q_{P_2} \rightarrow$ 1630 cfs → 1423.4 MSL → 25,500 Ac-ft

$$STOR_2 = \left(\frac{25,500 - 22000}{53.3 \times 16.0}\right) = 4.10''$$

$$\text{AVE STOR} = \frac{7.74 + 4.10}{2} = 5.92''$$

SURFACE AREA
5.92×16.0 Sq Mi $\times \frac{53.3 \text{ Ac-ft}}{\text{Sq Mi}} = 5049$ Ac-ft

STORAGE
½ PMF → 27,050 Ac-ft → 1424.8 MSL

PMF

$Q_{P_1} \rightarrow$ 17,600 cfs
$Q_{P_1} \rightarrow$ 1428.8 → 31,800 Ac-ft
Δ Storage = 9,800 Ac-ft

$$STOR_1 = \frac{9800}{53.3 \times 16.0} = 11.49'$$

$$Q_{P_2} = Q_{P_1} \times \left(1 - \frac{STOR_1}{19}\right)$$

$$Q_{P_2} = 17,600 \left(1 - \frac{11.49}{19}\right) = 6957 \text{ cfs}$$

$Q_{P_2} \rightarrow$ 6957 cfs → 1425.6 MSL → 28000 Ac-ft

$$STOR_2 = \left(\frac{28000 - 22000}{53.3 \times 16.0}\right) = 7.04''$$

$$\text{AVE STOR} = \frac{11.49 + 7.04}{2} = 9.27''$$

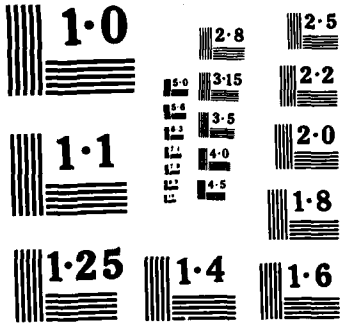
$9.27'' \times 16.0 \times 53.3 = 7905$ Ac-ft

PMF → 29,905 Ac-ft → 1427.2 MSL

Note 2nd iteration
done on Sht 8A
3/4/80

AD-A154 695 NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS 2/2
OTIS RESERVOIR DAM MA..(U) CORPS OF ENGINEERS WALTHAM
MA NEW ENGLAND DIV AUG 80

UNCLASSIFIED F/G 13/13 NL



NATIONAL BUREAU OF STANDARDS
MICROCOPY RESOLUTION TEST CHART

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JOB MA 308 Otis Reservoir
SHEET NO 8 OF 18
CALCULATED BY JFC DATE 6/10/80
CHECKED BY JMC DATE 7/20/80
SCALE

SUMMARY

	½ PMF	PMF
Inflow	8,800 cfs	17,600 cfs
Routed Outflow	4,200 cfs	11,900 cfs
Flood Elev.	1424.8 MSL	1427.1 MSL
Top of Dam	1422.5 MSL	1422.5 MSL
Depth of Overtopping	2.3 ft.	4.6 ft
Storage at Flood El.	27,000 Ac-ft.	29,900 Ac-ft
Spillway Cap. @ Flood El.	1600 cfs	2600

$Q_{1424.8} = (3.0)(38)(5.9)^{3/2} = 1633$ cfs

$Q_{1427.1} = (3.0)(38)(8.2)^{3/2} = 2676$ cfs - use 2600

Conduits - 2 @ 30" × 30"

$Q_{1427.1} = (0.6)(12.5)\sqrt{2(32.2)(36)} = 360$ cfs

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JOB MA 308 Otis Reservoir
SHEET NO 8A OF 18
CALCULATED BY JFC DATE 8/14/80
CHECKED BY _____ DATE _____
SCALE _____

Check to see if a 2nd iteration changes results of first run

½ PMF	PMF
$Q_{P_2} = Q_{P_1}\left(1 - \frac{\text{Ave Stor}}{19/2}\right)$	$Q_{P_2} = Q_{P_1}\left(1 - \frac{\text{Ave Stor}}{19}\right)$
$Q_{P_2}' = 8800\left(1 - \frac{5.92}{9.5}\right) = 3316$ cfs	$Q_{P_2} = 17{,}600\left(1 - \frac{9.27}{19}\right) = 9013$ cfs
1424.4 → 26,600 Ac-ft	1426.2 → 28,600 Ac-ft
$\text{Stor } 2' = \frac{26{,}600 - 22000}{53.3 \times 16.0} = 5.39"$	$\text{Stor } 2' = \frac{28{,}600 - 22000}{53.3 \times 16.0} = 7.74"$
$\text{Ave Stor}' = \frac{5.39 + 5.92}{2} = 5.66"$	$\text{Ave Stor} = \frac{7.74 + 9.27}{2} = 8.51"$
Surch. Ht. 5.66" × 16 × 53.3 = 4827 Ac ft	Surch. Ht. 8.51 × 16 × 53.3 = 7257 Ac-ft
½ PMF El. → 26,826 Ac-ft ≈ 1424.8 MSL	PMF_{EL} → 29257 Ac ft → 1426.8 MSL
Note: 2nd iteration does not significantly alter results of first run	Note: 2nd iteration does not significantly alter results of first run , 2 or, 3 -

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Berkshire Common - Third Floor North
PITTSFIELD, MASSACHUSETTS 01201
(413) 499-1560

JOB MA308 Otis Reservoir
SHEET NO 9 OF 18
CALCULATED BY JFC DATE 6/14/80
CHECKED BY JMC DATE 7/20/80
SCALE

Breach Analysis

Assume breach width W_b of 40% crest length at mid-Ht.

$$W_b = 0.4 \times 300 = 120' \checkmark$$

Assume breach occurs with water at top of dam

$$Q_p = 8/27\, W_b \sqrt{g}\, y_o^{3/2}$$

y_o = ht from stream bed to pool level at failure

$y_o = 30'$

Breach $Q_p = 8/27 \times 120 \times \sqrt{32.2} \times 30^{3/2} = 33,153$ cfs ✓

Spillway $Q_{\text{Top of Dam}}$ 450 cfs ✓

33,603 cfs ✓

Total Breach Q — USE 33,600 cfs ✓

Antecedent Disch (Spillway & Gates with water at top of dam 450+329 = 778 cfs ✓

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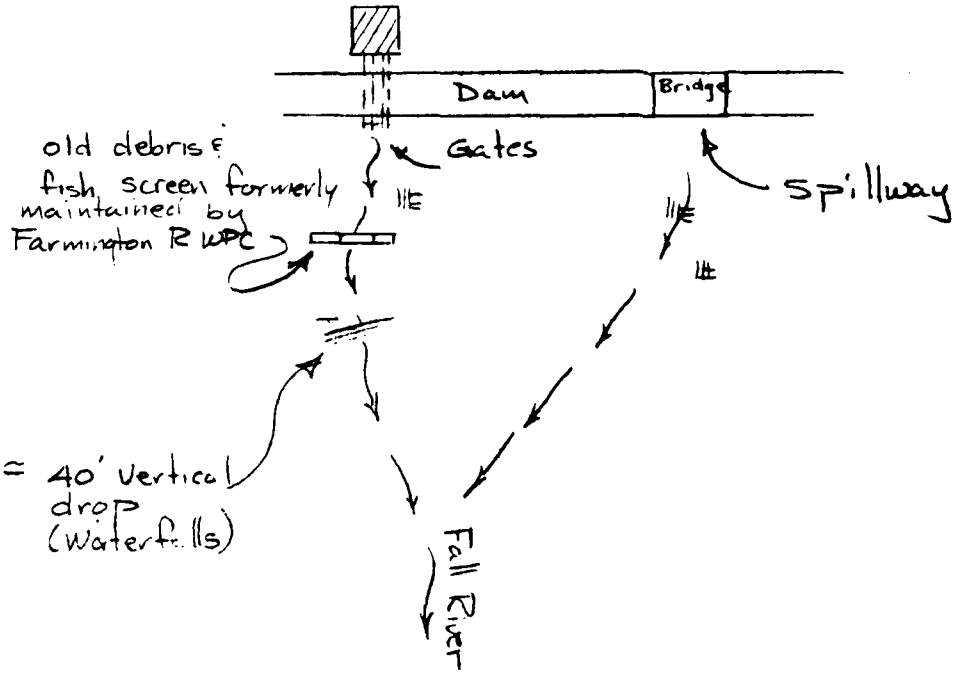
JOB MA308 Otis Reservoir
SHEET NO. 9A OF 18
CALCULATED BY JFC DATE 6/14/80
CHECKED BY JMC DATE 7/20/80
SCALE

Immediately downstream of dam, the channel of the Fall River is in bedrock. The channel falls steeply below the damsite as evidenced by photograph of vertical drop 300' D/s.



Fall River enters Farmington R. 0.95 mi D/s of dam site. Channel drops 240 feet in elevation between dam and Farmington R.
Channel is contained in a narrow valley section having steep side slopes.

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JOB MA 308 Otis Reservoir
SHEET NO 10 OF 18
CALCULATED BY JFC DATE 6/14/84
CHECKED BY JMC DATE 7/24/84
SCALE

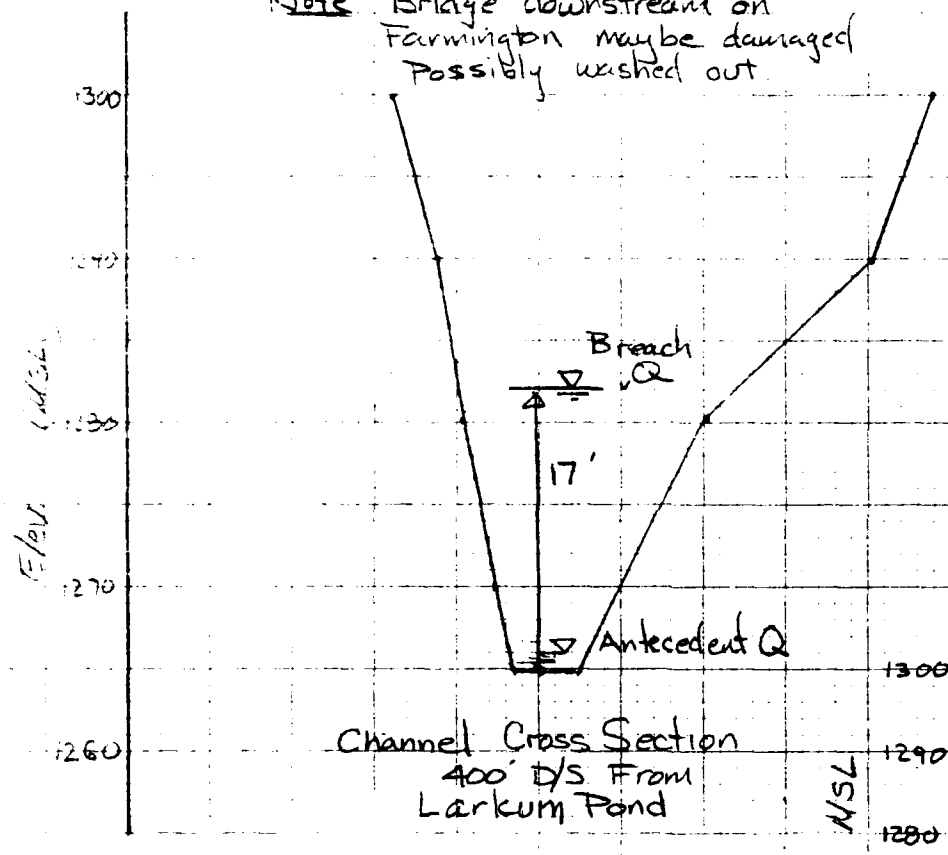
① Analyze Section 400' downstream of Larkum Pond. (Flood wave would raise level of Larkum Pond due to near perpendicular angle at which discharge channel from dam joins discharge channel from Larkin Pond. Change in direction would cause flood wave to loose velocity head. Severe erosion would occur in this area)
Camp Nawaka on Larkum Pond —
Note: New house built off channel d/s. of reservoir road. Reservoir Road crossing is only 2 - 6' culverts which would be overtopped and washed out by floodwave. Water would also likely flow down reservoir road toward new house.

Also because of large volume of storage 24,600 Ac-ft at top of dam, flooding from reservoir draining through breach would be of long duration (days).

② Analyze Section on Farmington R. 1.9 mi downstream of point where the Fall River enters the Farmington
Note: There is some floodplain storage upstream of this point. Also a family campground is located in this area.
Floodplain storage is small in relationship to storage in reservoir - Floodplain area on the order of 100 - 200 Acres including some area upstream of Fall R & Farmington in which water might be backed up.

Vsmc 7/.19.

Note Bridge downstream on Farmington maybe damaged Possibly washed out



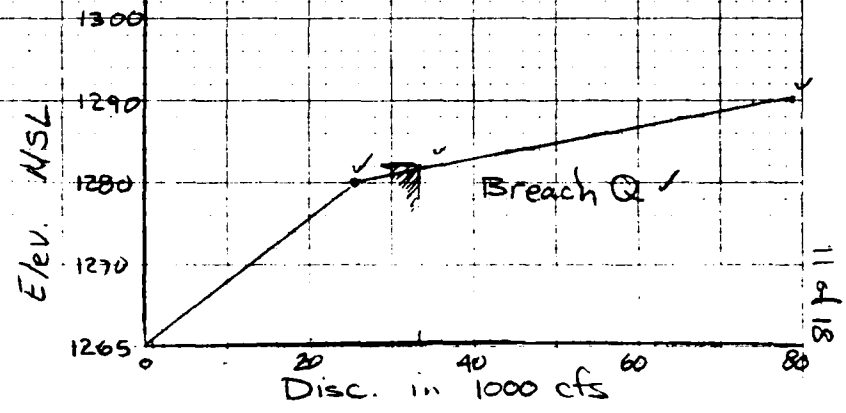
Channel Cross Section
400' D/S From
Larkum Pond

1"= 10' V
1"=200' H

S = 0.009 This area fairly flat
n = 0.07 Channel Gradient

$Q = \frac{1.49}{n} A R_H^{2/3} S^{1/2}$

El.	Area	W Per	R_H	Q	
1265	0	—	—	0	
1280	2810 ✓	300 ✓	9.37 ✓	25408 ✓	V = 9 fps ✓
1290	6960 ✓	535 ✓	13.01 ✓	78412 ✓	
1300	12860 ✓	640 ✓	20.10 ✓		



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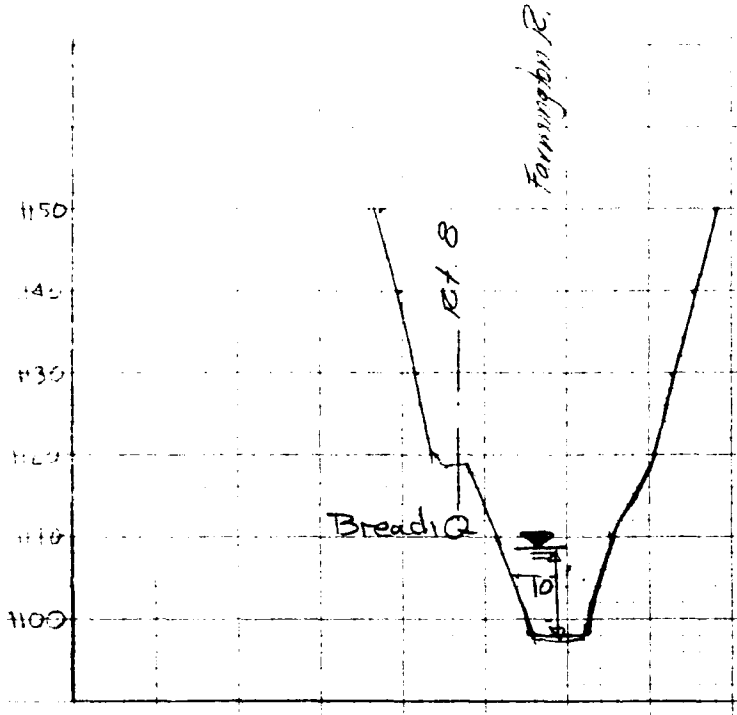
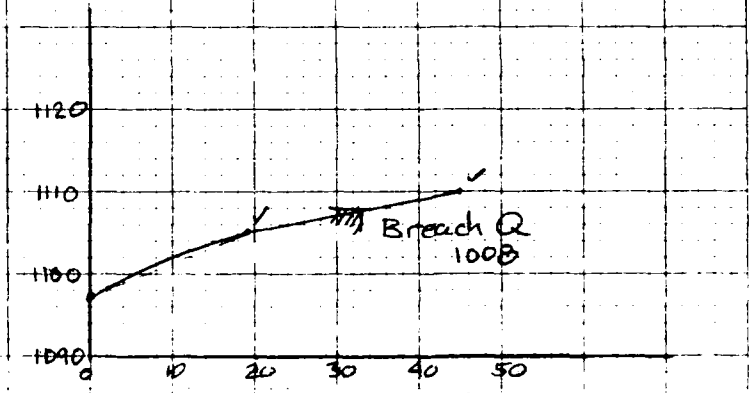
$S = 0.03$ $n = 0.07$ $Q = \frac{1.49}{n} A S^{1/2} R_h^{2/3}$

Elev.	Area	Wper	R_h	Q	
1097	0			0	
1105	1480	225	6.58	19280	
1110	2730	295	9.25	44695	V = 16.4 fps
1120	7475	550	13.59	158,312	



Cross Section
Farmington R
1.9 Mi. D/s of
Confluence w/ Fall R.

1" = 20' V
1" = 400' H



Note Flood of 5-6' depth in Disc 1000 cfs
Campground u/s of this
cross Section
Velocity 16 fps ± high at this section

12-24-18

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JOB MA 308 Otis Reservoir
SHEET NO 13 OF 18
CALCULATED BY JFC DATE 6/18/80
CHECKED BY JMC DATE 7/30/80
SCALE

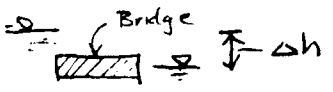
③ Analyze condition at Village of New Boston at Rt. 8 Bridge Near Junction of Rt 57

Analyze Opening as Open Channel up to Bottom of lower Chord of bridge Truss.
Analyze over the road flow as weir flow.
Flow thru bridge opening considered as orifice flow for stages above road

Open Channel $S = 0.01$, $n = 0.04$ $Q = \frac{1.49}{n} A S^{1/2} R_H^{2/3}$

Elev.	Area	W_p	R_H	Q
826	0			0
835	675	93	7.26	9490
837	825	97	8.51	12901

Orifice flow $q = CA\sqrt{2g\Delta h}$ use $C = 0.7$



Elev	Area	Δh	Q
845	1050	5'	13189
850	1050	7'	15605
855	1050	9'	17695

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JOB MA 308 Otis Reservoir
SHEET NO 14 OF 18
CALCULATED BY JFC DATE 6/18/80
CHECKED BY JMC DATE 7/20/8[illegible]
SCALE

Weir Flow - (Don't include area of Trusses; Rails)
Note: Bridge did not wash out in 1955
$Q = KLH^{3/2}$ $K = 2.6$

Elev.	K	L	H	Q
845	2.6	275 ✓	1 ✓	715 ✓
850	2.6	325 ✓	6 ✓	12419 ✓
855	2.6	325 ✓	11 ✓	30828 ✓

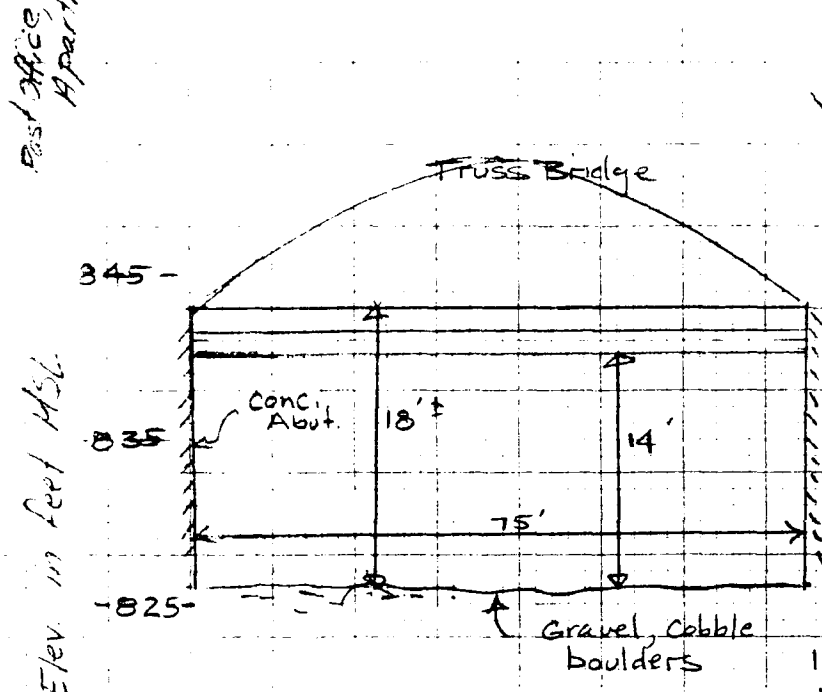
Note: Assume bldg east of bridge goes also bldg at west, d.s. of bridge

Summary of Flow v Elev. at Rt 8 Crossing at New Boston near Jct. w/ RT 57

Elev	Q	
826	0 ✓	
835	9490 ✓	
837	12901 ✓	—
845	13904 ✓	
850	28024 ✓	orifice & weir flow
855	48523 ✓	

See Plot P. 17

R.G. Brown & Assoc. Inc.
JFC 6/18/80
VJMC 7/20/80



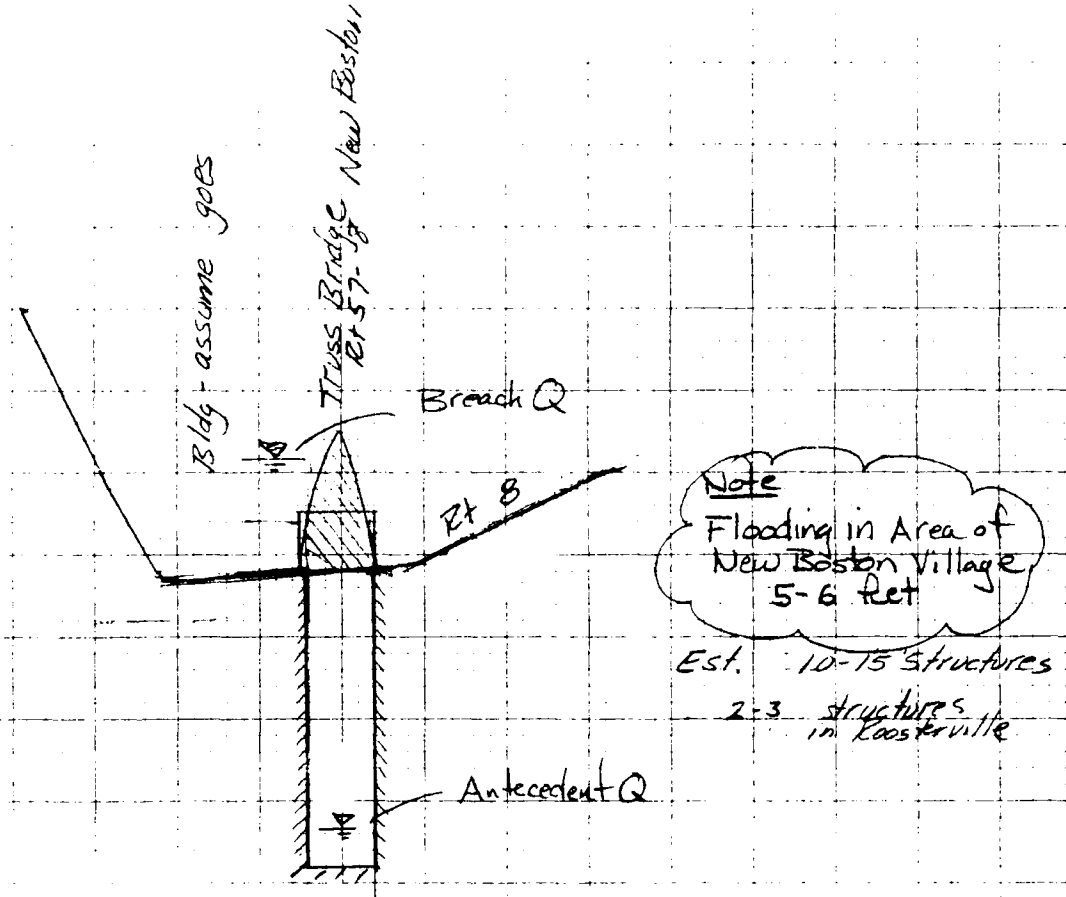
1" = 20' H
1" = 10' V

Note: Elev. Datum from USGS Quad- Not by Survey

Bride at Rt. 8 New Boston Village
near Junction w/ Rt. 57

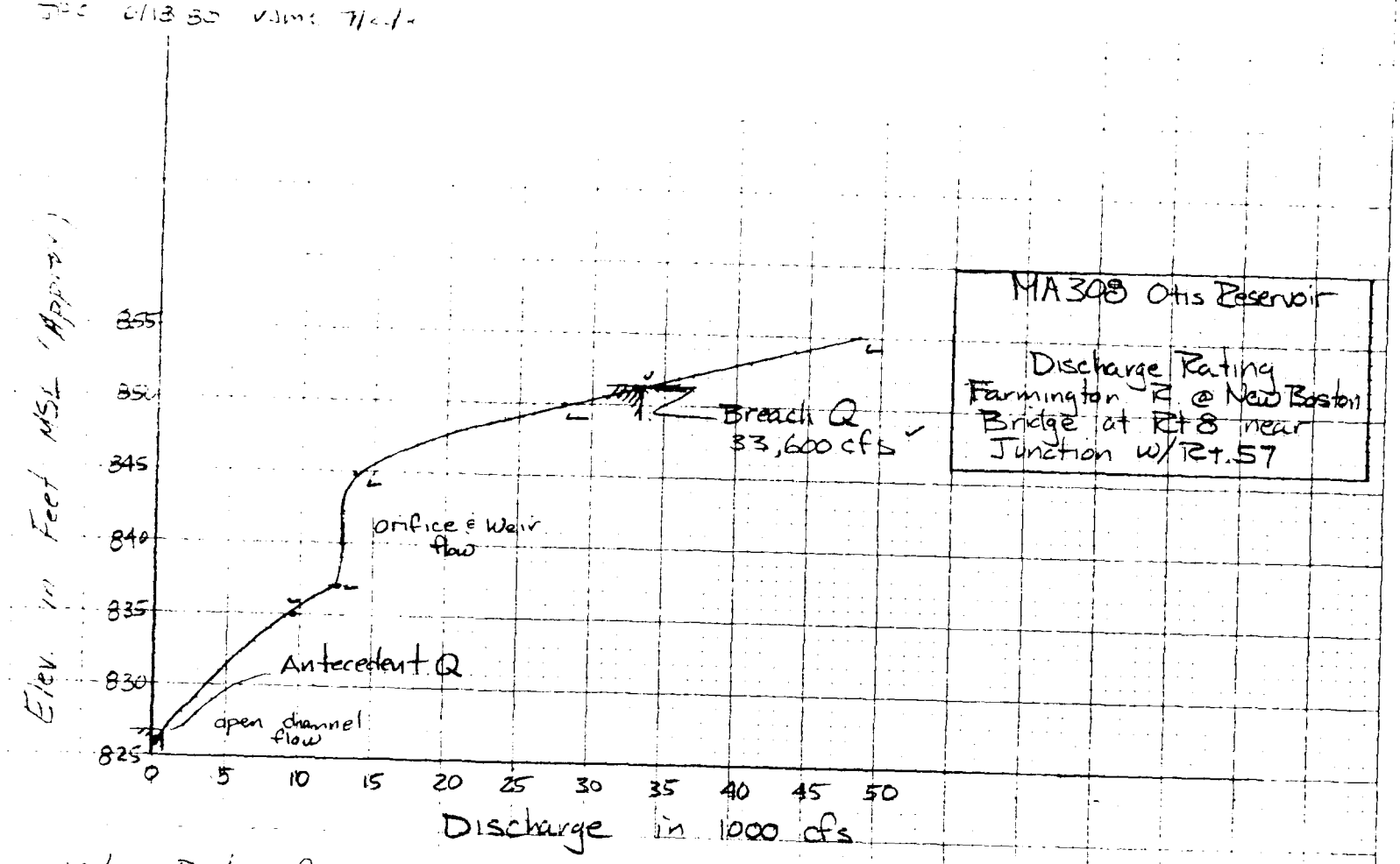
p. 15 of 19

R.S. Brown Assoc. Inc
FPC 6/15/80
JMC 7/29/81



Expanded Cross Section
Bridge at Rt 8 New Boston Village
Near Junct. w/Rt 57
Looking D/S

P. 16.13



Note: Datum from USGS Quadrangle
to be Survey
Approximate Only

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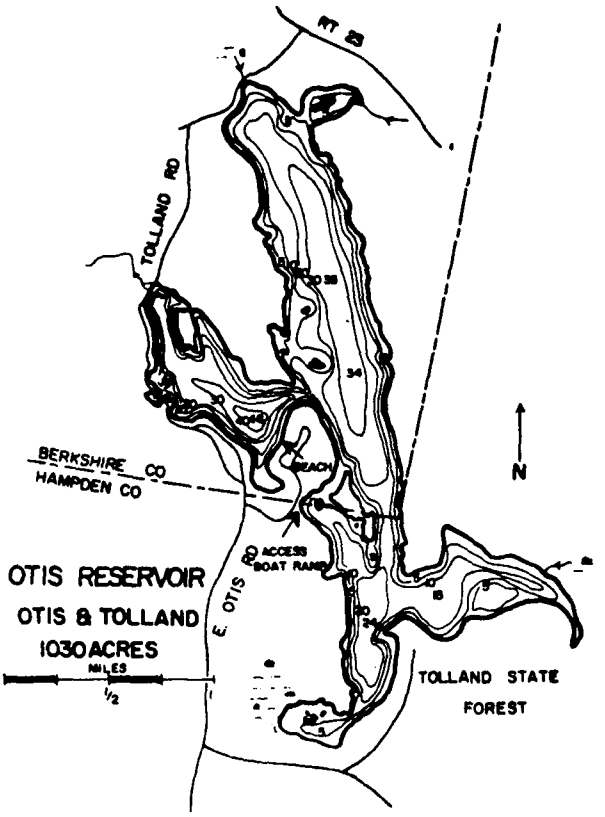
JOB MA308 Otis Reservoir
SHEET NO 18 OF 18
CALCULATED BY _____ DATE _____
CHECKED BY _____ DATE _____
SCALE _____

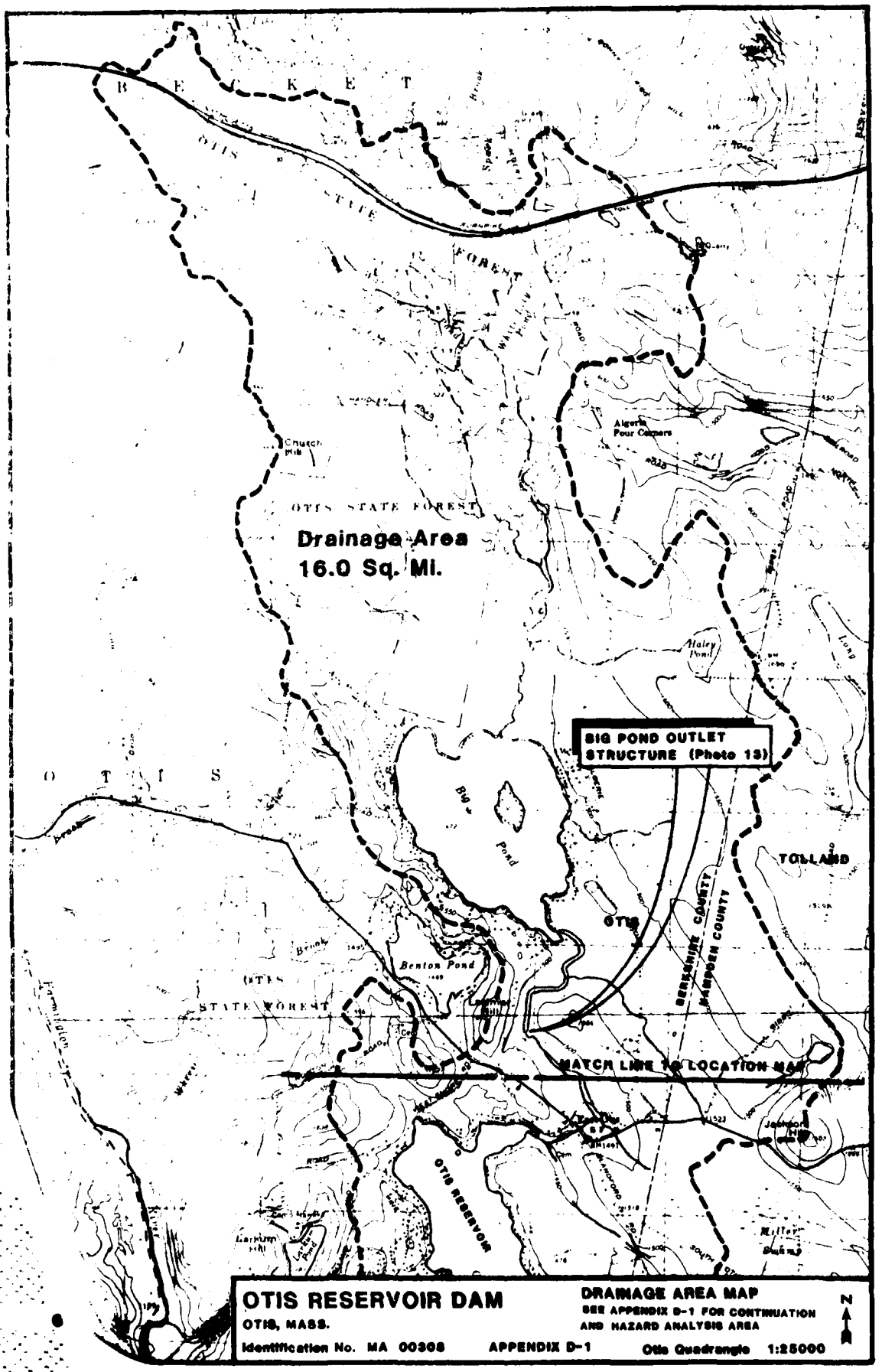
Data From: Inventory of Ponds, Lakes, and Reservoirs of Massachusetts Berkshire & Franklin Counties by J.A. McCann & L.M. Daley Univ. of Mass. Water Resources Research Center Pub. No. 10-2

EAST OTIS RESERVOIR,OTIS RESERVOIR,CLARKS PD, TOWN-OTIS WATERSHED-FARMINGTON R, ACRES- 1288
ACCESS-PAYACCES ALTITUDE-1421 MEAN DEPTH-20 MAX DEPTH-040 MAP-YES WATER TYPE-COLDWARM TROUT WATER-09
POND TYPE-ENHANCED LIMNO CLASS-OLI STRATIFIED-YES TRANSPARENCY-13 WATER COLOR-CLEAR PROD.-
VEGETATION-COMMON POLLUTION DEGREE- TYPE- BOTTOM TYPE- STOCKED-COLD WATER RECLAIMED-NO
POND USE-DEG, FLOOD C-3 BOATING-3 SWIMING-3 WATRSKI-3 FISHING-3 ICEFISH-3 SKATING-1 CAMPING-2
LAND DEVELOPMENT RESDNT-6 PARK-4
TOPO SHEET-111 POSITION UP-05.0 RIGHT-11.5 SHORELINE DIST-19. INLET- OUTLET- SHORELINE TYPE HIGH-4 INT-5 LOW-1
DIST,DIR FROM TOWN-3.0,SE LAND USES-RESDNT-5 WOODED-9 PARK-3 SWAMP-1
REM-STATE ACCESS IN TOLLAND STATE PARK,ALSO IN HAMPSHIRE CO., TOLLAND
REM-GREAT POND MANAGED FOR BASS,CP,WP,YP,BM FLUCTUATING RESERVOIR
REM-NOT SURVEYED



APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS



OTIS RESERVOIR DAM
OTIS, MASS.
Identification No. MA 00308

DRAINAGE AREA MAP
SEE APPENDIX D-1 FOR CONTINUATION AND HAZARD ANALYSIS AREA

APPENDIX D-1

Otis Quadrangle 1:25000

N

END

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DTIC